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Vol. II

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1944

#2

No. 184

GRAVER TANK & MFG. CO., INC., THE LINCOLN ELECTRIC COMPANY, GRAVER TANK & MFG. CORPORATION, PETITIONERS,

vs.

THE LINDE AIR PRODUCTS COMPANY

No. 185

GRAVER TANK & MFG. CO., INC., THE LINCOLN ELECTRIC COMPANY, GRAVER TANK & MFG. CORPORATION, PETITIONERS,

vs.

THE LINDE AIR PRODUCTS COMPANY

[redacted]

[redacted]

[fol. 1045] This invention relates to a method of electric arc welding in deep flux, and also to the flux employed.

The simplicity of bare wire-electrode welding recommends it above all other methods. It is unfortunate that the metallurgical and physical properties of metal deposited in this simple manner are so poor as to make the method unsuitable where reliability and ductility are prime requisites. Fluxes, being non-metallic in nature and generally applied to the exterior of the electrodes render it impossible to make electrical contact with the electrode except at certain intervals where the rod has been bared to permit contact. This obstacle assumes great proportions in automatic arc-welding wherein a continuously fed electrode must be used. When these bared sections reach the melting zone metal of inferior quality is deposited. The current must pass through a variable length of rod, the length between the arc and the contact point, heating it sufficiently to crack off the flux covering and further to add an IR drop to the arc voltage. This IR drop is not constant in magnitude but varies according to the position of the contact point relative to the arc. The relay, unable to discriminate between arc voltage and electrode drop, cannot maintain the constant arc length so necessary to successful welding unless compensatory means are resorted to. These difficulties therefore limit the energy which may be expended in the arc. We are not aware of current values in excess of about 500 amperes being used in this manner of welding. The energy limitations above mentioned make the welding of heavy plate a multiple pass process. The soundness or homogeneity of the metal cannot be assured unless the fused flux is removed between successive passes. Accumulated stress is introduced into such welds. Unless each layer of deposited metal is peened to relieve this stress the united parts will have been deflected through [fol. 1046] the agency of this stress.

There is another means of applying protective flux. It consists in utilizing a thick coating of finely divided material, a flux, which covers the seam to be welded. The welding electrode, which is a bare wire of suitable composition, is fed down by conventional feeding means and the arc is struck under this powdered flux. The electrode is traversed at a constant rate along the path to be welded. The process is such that the operator cannot see the progress of the weld, the arc being submerged in the fluxing material. Direct current is employed at a voltage of about 30 volts with current

values up to 900 amperes. The flux used in this system has been, in the past, a natural clay of approximately the composition used in making brick. Specifically the following is an analysis of such a flux:

SiO_2	50.6%
Al_2O_3	18.86
Fe_2O_3	4.34
CaO	5.00
Mn	6.00
Fe	3.03

This method, retaining as it does the advantage of feeding current to a bare wire at a point adjacent to the weld, is seriously deficient in the quality of the weld metal deposited. A weld made by this method has ample strength but is so porous that it can hardly be said to be satisfactory. It is therefore customary to hand weld on the opposite side to insure superficial freedom from holes. It has not been found possible to extend this method beyond ½ inch plate and there is no immunity from holes in any thickness.

The vigor of the arc submerged under this dust projects [fol. 1047] a continuous cloud of material into the atmosphere. An evidence of the amount of gas that is emitted by a flux of this nature is afforded by the fact that the welders very frequently wear gas masks to protect themselves from the dust. Since the dust is thrown up by the gas that is evolved from the flux and the weld metal, it is not surprising that gas holes should be found in the metal of the weld.

It is the purpose of this application to deal with a new method, designated as submerged-arc electric welding, wherein a bare wire electrode of any diameter may be employed and in which plates of 1½ inches thickness may be welded in a single operation by a weld whose density is equal to the parent metal and whose properties are such as to inspire confidence in any application. Furthermore, the weld is of such low internal stress that no evidence of plate deflection is apparent after its completion. It is well known that all insulating materials become increasingly conductive as their temperature rises and finally, when in a molten state, they exhibit the well known electrolytic phenomenon which is the basis of the aluminum industry. It was therefore deemed desirable in order that gas liberation be re-

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THE LINDE AIR PRODUCTS COMPANY

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ON WRITS OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SEVENTH CIRCUIT

VOL. II

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JUDD & DETWEILER (INC.), PRINTERS, WASHINGTON, D. C., NOV. 18, 1948.

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[fol. 1042] PLAINTIFF'S EXHIBIT 125

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Department of Commerce

United States Patent Office

To all persons to whom these presents shall come, Greeting: This is to Certify that the annexed is a true copy from the records of this office of the File Wrapper and Contents, in the matter of the Abandoned Application of Lloyd T. Jones, Harry E. Kennedy and Maynard A. Rotermund, Filed February 21, 1933, Serial Number 657,836, for Improvement in Method of Electric Arc Welding and a Flux Therefor.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington, this fourth day of October, in the year of our Lord one thousand nine hundred and forty-five and of the Independence of the United States of America the one hundred and seventieth.

Casper W. Ooms, Commissioner of Patents. (Seal.)

Attest: T. A. Coulter, Acting Chief of Division.

duced to a minimum that a flux be produced capable of operation with alternating current in order that the effect of this phenomenon might be controlled. Such a flux was produced.

When an electric current is passed through a material which becomes a Nernst conductor at a low temperature a relatively large area of the material will be engaged in the conduction. Common salt (Na Cl) is a material of this class. If it is used as a flux the current is conducted from the electrode to the plate almost entirely by the fused electrolyte. So much salt is involved in the conduction that the [fol. 1048] energy density is insufficient to produce fusion of the plate or wire. If on the other hand a material becomes a Nernst conductor at an exceedingly high temperature, very little of the material is involved in the conduction, the energy is thereby so concentrated as to melt very deeply and with very small cross section. An example of the latter type of material might be common sand. From the foregoing it is clear that by a proper selection of flux, the energy density on the parts to be welded may be controlled and that electrolysis with its consequent production of gas may be avoided by the use of alternating current. However, alternating current has been entirely unsuitable with fluxes heretofore used. In the sample analysis of a customary flux it will be noted that silica is present to the amount of 50%. We have noticed in analyses of welds made with the usual flux and direct current that the silicon content of the metal after welding exceeds that of the parent metal or the rod while the carbon content is less than either. Such welds are invariably full of holes. A rational explanation is that the carbon of the weld metal reduces the silica of the flux with the generation of carbon monoxide and the release of silicon, according to the well known chemical reaction.

We have formed a flux, consisting of two components, one acid and one basic. More specifically stated a flux may be formed by fusing as a base calcium carbonate and silicon dioxide in such proportions as to form a neutral slag, the resultant compound being principally calcium silicate. After fusion the material is finely ground, laid upon the seam to be welded, the electrode submerged in the powdered material and the arc struck. The welding proceeds under this material unobtrusively, the operator hardly cognizant that welding is taking place. Such a flux has extreme penetrating power, so great in fact that a solid plate $1\frac{1}{4}$ inches

NUMBER (Series of 1928)

657836

DIV. 603

ATENT NO.

1933

DATED 05-7-7

(EX'R'S BOOK)

Name LLOYD T. JONES, HARRY E. KENNEDY AND MAYNARD A. ROTERMUND

of BERKELEY

State of CALIFORNIA

Invention METHOD OF ELECTRIC ARC WELDING AND A FLUX THEREFOR

ORIGINAL		RENEWED
APPLICATION FILED COMPLETE	FEB 21, 1933	
APPLICATION FILED — Petition, Specification, Oath, First Fee $30, ~~sheets~~ Drawings,	FEB 21, 1933	This application referred to in Patent No. 2043460
PARTS OF APPLICATION FILED — 1 EXTRA CLAIM $1	FEB 21 1933	Do not destroy. (See order No. 3166, 400 O.G. 1)
		DO NOT DETACH
Examined and passed for Issue, 193		Reexam'd and passed for Issue, 193
Exr. Div.		Exr. Div.
Notice of Allowance, 193		Notice of Allowance, 193
By Commissioner.		By Commissioner.
Final Fee, 193		Final Fee, 193

Division of App., No. filed

Attorney ~~TOWNSEND & LOFTUS 907 CROCKER BLDG SAN FRANCISCO CALIF~~

Charles C. Scheffler & Eugene L. Greenewald, 30 East 42nd St. New York, N. Y.

Associate Attorney

No. of Claims Allowed ____ Print Claims ____ in O. G. Class ____

Title as Allowed

1043

10414

FEB 21 33 693 672 K ... 30.00

PETITION FEB 21 33 693 671 K ... 1.00

PATENT DIVISION FEB 21 '33

657836

TO THE COMMISSIONER OF PATENTS:

YOUR PETITIONERS, LLOYD T. JONES, HARRY E. KENNEDY and MAYNARD A. ROTERMUND, Citizens of the United States of America, and all residents of Berkeley County of Alameda, and State of California, whose joint Post Office address is 105 Tunnel Road, Berkeley, California

pray that Letters Patent may be granted to them for the improvements in

set forth in the annexed specification; and they hereby appoint Townsend & Loftus, a firm composed of Chas. E. Townsend, Wm. A. Loftus and Thos. Castberg, whose address is 907-917 Crocker Building, San Francisco, California, their Attorneys, with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to receive the Patent, and to transact all business in the Patent Office connected therewith.

Signed at

County of, and State of

this day of

In signing, the first or given name should be written in full.

{ [illegible] }

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN, that we, LLOYD T. JONES, HARRY E. KENNEDY and MAYNARD A. ROTERMUND, Citizens of the United States, residing at Berkeley County of Alameda, and State of California, have invented new and useful improvements in METHOD OF ELECTRIC ARC WELDING AND A FLUX THEREFOR

of which the following is a specification:

1044

1

[fol. 1049] thick will be penetrated almost instantly by a current of 1600 amperes. In order to cause the energy to be distributed over a larger area we added, in various proportions, a material capable of reducing the energy concentration and thereby widening the weld. A preferable material for this purpose is calcium fluoride. This material in proper amount functions in exactly the same manner as increasing the arc voltage, but without the usual disadvantage, of a long arc. There are of course other materials which function in a similar manner; calcium chloride, sodium chloride, etc., and there are other materials suitable to form the main body of the flux. Magnesium silicate, manganese siliate, or these in combination serve admirably. When the arc is struck the energy liberated instantly fuses that portion of the flux in the immediate vicinity. The weld penetrates to a depth dictated by the composition of the flux and the voltage and current employed. The electrode feed motor supplies the electrode material at such a rate as to maintain an arc potential of approximately 32 volts. The travel motor causes the electrode to traverse the seam at such a rate as to completely fill the groove which has been provided by beveling the plates before their abutment. Under these conditions it is perfectly possible to produce a weld in a plate 1½ inches in thickness at a rate of approximately six inches per minute with a current of 1600 amperes. Further, we have found it possible to introduce desirable elements into the weld metal by incorporating the particular elements as compounds in the flux. Thus, when we use manganese silicate we may introduce manganese into the weld. Carbon may be given to the weld metal by incorporating it as calcium carbide in the flux. While we prefer to form our flux by introducing a mixture of compounds into a furnace and fusing them at such a temperature that no further chemical [fol. 1050] action will take place, we have formed fluxes from their solutions; $Na_2 SiO_3 + CaCl_2 \rightarrow Ca SiO_3 + 2 Na Cl$. The calcium silicate thus obtained is equally effective as a flux. It has heretofore been regarded that the chief requirement of a flux was that it exclude the atmosphere which was held responsible for most welding evils. We have found that a fluid flux not only serves this end but through a proper control of melting point, its temperature-resistance characteristic and the proportions of its chemical constituents it can expand the welding field far beyond its present limitations. A further very necessary property is

that the flux be readily removed at the completion of the weld. That portion of the material that has not been fused is removed by a vacuum system to be returned to its storage tank. That which has been fused lifts off intact from the weld exposing a perfectly symmetrical uniform weld. A cross section of our weld shows the fused metal to have almost parallel sides and to be almost independent of the character of the vee. Since the amount of metal solidifying is uniformly wide, unequal stresses tending to warp the plate do not exist.

It is quite possible with our flux to use direct current, or it is possible to superimpose direct current on alternating current. Alternating current alone is preferable.

A vast number of experimental welds support the conclusion that the properties of a successful flux for this method of welding are these:

(1) The chemical reactions between the components of the flux must be completed before it is used in welding. Failure in this regard most surely invites porosity.

(2) It must be capable of controlling the penetration and the width of the weld.

(3) Its melting point must be such that it will not become entrained with the molten metal.

[fol. 1051] (4) It must consist of chemicals which are not detrimental to the properties of the steel, and

(5) It must be readily removable from the finished weld.

The composition of the flux is of the utmost importance. The particular composition that is to be used is determined by the quality and thickness of the metal plates to be welded, by the current and voltage to be used, and by the properties it is desired to impart to the weld metal.

We have used calcium silicate and silicates of sodium, barium, manganese, cobalt, magnesium, nickel and aluminum, both in binary and ternary combinations, in various proportions.

We have used calcium titanate and various titano-silicates, these being used when it is desired to introduce titanium into the weld metal.

In order to control the fluidity of the resulting compound we adjust the proportions previous to fusion. In order to further control the fluidity and electrical conductivity we also utilize a fluxing agent.

Besides the fluxing properties that may be ascribed to the various oxides used in forming the flux we add borax, boric acid, sodium chloride, calcium chloride, feldspar, fluorspar, or sodium tungstate. The choice of fluxing agent is of small importance in general. It may be stated that the addition of boron compounds to the flux will add boron to the steel. Silicon, manganese, nickel and other ingredients may be added to the weld metal deposited by properly adding their compounds to the flux.

The depth to which the parent metal is melted by the operation of the arc is also controlled by the composition of the flux. In many instances where a welding operation is taking place the penetration obtained when metallic silicate alone is employed will be unsuitable, that is pene- [fol. 1052] tration may be too shallow or too deep, hence an agent controlling penetration is desirable and is combined with the flux. Such an agent may be one of the halogen or alkali metal compounds, such as sodium chloride, calcium chloride, fluoride, etc. These compounds, when combined with a metallic silicate, titanate, or phosphate vary the melting point of the flux and as such aid in controlling the penetration when welding is taking place. By changing the proportions of the flux during its preparation we have been able to cause an arc of 1500 amperes to melt to a depth of 1.5 inches in solid steel plate or to melt to a depth of only 0.1 inch. Since in welding we encounter conditions requiring large penetration as well as conditions making it desirable that penetration be small, we do not wish to be limited to a particular composition that will make other than a single depth of penetration impossible. Depth of penetration is also a function of voltage, current, size of welding wire or rod and speed of traverse.

The metallic silicates employed do not readily dissociate. If it is desired to introduce a metal that will alloy with the weld metal manganese, nickel or like metals may be added, as compounds, to the flux. They are not necessarily added in the metallic state but may be added as silicates of the metals; for example if manganese is to be added a predetermined proportion of manganese silicate is added to calcuim silicate, preferably by fusing. The main body

material of the flux is always composed of two components, one acid and one basic. These components are combined by fusion, and if proper proportions are employed, a neutral flux results. If it is desired to alloy the weld metal, either the acid or the basic component forming the flux may be added in excess in order to cause to enter the weld metal [fol. 1053] the metallic component of either the acid or the basic member.

Particular fluxes that we have used are as follows:

(1) Calcium silicate both fused and chemically precipitated, proportions varying from $2CaO.SiO_2$ to $CaO.3SiO_2$. Fluxing materials added: sodium silicate, borax, boric acid, alumina, fluorspar, feldspar, calcium chloride, sodium chloride.

(2) Manganese silicate $MnO.SiO_2$

(3) Calcium-Magnesium silicate $CaO\ MgO\ SiO_2$

(4) Calcium Iron silicate $CaO\ FeO\ SiO_2$

(5) Calcium Aluminum silicate $CaO\ Al_2O_3\ SiO_2$

(6) Calcium Titano-silicate $Ca\ Ti\ SiO_5$

In particular a flux may be formed as follows: Calcium carbonate, sodium carbonate and silica are mixed in such proportions that one-half the silica will be used in forming calcium silicate and one-half used in forming sodium silicate, there being no excess of the carbonates. To the mixture is added ten per cent of borax or boric acid. This mixture is then fused, poured and cooled and finally ground to a fine powder. A smaller amount of borax may suffice depending upon the temperature available in the melting furnace.

It is obvious that variations may be made in the particular proportions of the compounds used with a consequent change in the melting point and electrical conductivity. For the more penetrating fluxes it is desirable to increase the amount of silica to such a degree that uncombined silica remains.

When uncombined silica is present in the flux the heat of the arc decomposes the silica or in any event renders it more easily transferable to the weld metal. For each molecule of silica dissociated there will also be liberated a molecule of oxygen. This molecule, if thermally liberated, is free to escape as a gas, if liberated electroly-

[fol. 1054] tically it may attach the carbon content of the metal.

[fol. 1055] Having thus described our invention, what we claim and desire to secure by Letters Patent is—

Per B

1. A fluxing material for electric arc welding consisting of two components, one acid and one basic.

2. A fluxing material for electric arc welding consisting of a body material composed of two components, one acid and one basic, and another material whereby the energy density of the arc on the parts to be welded is controlled.

3. A fluxing material for electric arc welding consisting of a body material composed of two components, one acid and one basic, and another material whereby the electric conductivity of the flux is controlled.

4. A fluxing material for electric arc welding consisting of a body of material composed of two components, one acid and one basic, and a compound whereby metal deposited during welding is alloyed.

5. A method of forming a fluxing material for electric arc welding which consists in mixing two components, one acid and one basic, causing a substantially complete chemical reaction between the components by subjecting them to a sufficient temperature to cause fusion, and then cooling and grinding the fused material.

[fol. 1056] 6. A method of electric welding which consists in subjecting the parts to be joined to the action of an electric current, said current passing substantially wholly through a flux placed on the parts to be joined, said flux consisting of two components, one acid and one basic, chemical reaction between the components having been previously completed.

7. In electric arc welding employing a flux, a method of controlling penetration of the arc which consists in controlling the melting point of the flux.

[Matter enclosed between rules erased in copy.]

8. In electric arc welding employing a flux, a method of alloying the metal deposited during welding which consists in adding a metallic compound to the flux.

9. A method of electric arc welding with alternating current which consists in substantially enclosing the arc in a flux having sufficient conductivity to re-establish the arc between alternations of the current.

Per B

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10. A fluxing material for submerged electric arc welding composed of a metallic silicate.

11. A fluxing material for electric arc welding comprising metallic silicate and a halogen compound.

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12. A fluxing material for electric arc welding comprising metallic silicate and calcium fluoride.

Per B

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13. A fluxing material for electric arc welding comprising metallic silicate and another material for controlling the composition of the metal deposited during welding.

[fol. 1057] 14. A method of producing a fluxing material for arc welding which consists in mixing silica and lime, heating said material to a sufficient temperature to produce calcium silicate, and then cooling and granulating the calcium silicate.

Per A. 15. [In an electric arc welding system employ-
A
" A. ing a flux, a]* ^ method of alloying the metal
electric arc
" A. deposited during ^ welding which consists in
and
" A. adding a metallic compound to the flux, ^ reducing the flux and the added metallic compound to a
thereby

[Matter enclosed between rules erased in copy.]
[* Words and figures enclosed in brackets erased in copy.]

Per A. fluid state by means of the heat of the arc, [and]* transferring by electrolysis the metal of

---

the metallic compound to the molten metal deposited by the arc.

16. A method of electric ... welding in the presence of a flux which consists in substantially enclosing the arc in a flux which has been rendered chemically inactive.

17. A method of preparing a flux for electric welding which consists in precipitating a metallic silicate from a soluble silicate.

18. In submerged electric arc welding a method of preventing gas formation during welding which consists in alternately reversing the polarity of electrodes.

19. A method of electric welding which consists in subjecting the parts to be joined to the action of an electric current passing substantially wholly through a flux placed on the parts to be joined, said current being periodically reversed to prevent electrolysis, said flux consisting of two components, one acid and one basic, the chemical reaction between which has been previously completed.

[fol. 1058] Per B

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20. A fluxing material for electric arc welding consisting of two components, one acid and one basic, the acid component being in excess in order to cause to enter the weld metal the metallic component of the acid member.

21. A fluxing material for electric arc welding consisting of two components, one acid and one basic, the basic member being in excess to cause to enter weld metal the metallic component of the basic member.

Insert B'.>

Lloyd T. Jones, Harry E. Kennedy, Maynard A. Rotermund.

[* Words and figures enclosed in brackets erased in copy.]
[Matter enclosed between rules erased in copy.]

STATE OF CALIFORNIA,
County of Alameda, ss:

Lloyd T. Jones, Harry E. Kennedy and Maynard A. Rotermund the above-named petitioners, being sworn (or affirmed), depose and say that they are citizens of the United States of America, and residents of Berkeley, County of Alameda, State of California; that they verily believe themselves to be the original, first and joint inventors of the improvements in Method of Electric Arc Welding and a Flux Therefor described and claimed in the annexed Specification; that they do not know and do not believe that the same was ever known or used before their invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof, or more than two years prior to this application, or patented in any country foreign to the United States on an application filed more than twelve months before this application, or in public use or on sale in the United States for more than two years prior to this application; and that no application for patent on said improvements has been filed by them or their representatives or assigns in any country foreign to the United States; and the said Harry E. Kennedy hereby states that his full first name is "Harry".

Lloyd T. Jones, Harry E. Kennedy, Maynard A. Rotermund. (Notary Seal.)

Subscribed and sworn to before me this 11th day of February, 1933. Wm. J. Vaughan, Notary Public in and for the County of Alameda, State of California.

Oath or affirmation must be made before a Notary Public, Who Must Affix His Seal on the Gold Wafer. If Notary has no seal, a certificate of the Judge or Clerk of the Court, showing that the Notary is qualified, must be attached. If the oath is taken before a Justice of the Peace, a certificate of the Judge or Clerk of the Court, showing that such Justice is qualified, must be attached.

[fol. 1060] 260

Department of Commerce, United States Patent Office, Washington.

Div. 60. Room 5896

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

Paper No. 2. All communications respecting this application should give the serial number, date of filing, and name of the applicant.

RLS-FR

May 27, 1933.

Please find below a communication from the Examiner in charge of this application.

Thomas E. Robertson, Commissioner of Patents.

Applicant: L. T. Jones et al. Ser. No. 657,836. Filed Feb. 21, 1933. For Method of Electric Arc Welding etc.

Townsend & Loftus, 907 Crocker Bldg., San Francisco, California

This case has been examined. References made of record:—

Whitcomb, 277,393 May 8, 1893 148-26.
Miller, 1,748,785 Feb. 25, 1930 148-26.
Vervaet, 720,300 Feb. 10, 1903 148-26.
Robinoff et al, 1,782,316 Nov. 18, 1930 219-10-67.

The claims herein are drawn to three separate and distinct inventions. Thus:

I claims 1 to 4, 10 to 13, 20 and 21 which recite a flux,
II claims 5, 14 and 17 which recite a method of producing a flux, and
III claims 6 to 9, 16, 18 and 19 which recite a method of electric welding.

Division is required in accordance with Rule 42. The methods of groups II and III are separate and distinct methods one leading to creation of a flux, the other leading to the making of a welded joint. Further, methods other than that claimed in group II may be resorted to when making the flux of group I while the process of group III may be practiced with fluxes other than that of group I or with

the flux of group I made by a process other than that of group II.

It is to be noted that claim 15 is not included in the above grouping. This claim initially recites "in a welding *system*" which recitation is followed by the recitation "a method of alloying." Then follows recitation of a step [fol. 1061] executed in the production of the flux group I and finally there is recited the inherent chemical reactions which occur when the flux is utilized in a welding process. Classification of the claim will depend upon the nature of amendment thereof so as to render the claim sufficiently definite that the nature of the invention claimed can be ascertained.

Art cited is the result of a cursory search and is cited to aid the applicant in his election and to indicate classification of the respective inventions.

An action on the merits awaits settlement of the question of division.

R. L. Glass, Examiner.

[fol. 1062] Department of Commerce, United States Patent Office

Div. 60 Room 5896

Paper No. 3

[Stamp:] U. S. Patent Office, Nov. 17, 1933. Division 60.

In re application of Lloyd T. Jones, Harry E. Kennedy, and Maynard A. Rotermund, Filed February 21, 1933, Serial No. 657,836, For Method of Electric Arc Welding and a Flux Therefor.

San Francisco, California, November 13, 1933.

Hon. Commissioner of Patents, Washington, D. C.

Sir:

In response to the official action of May 27th, 1933, the above entitled application is hereby amended as follows:

Claim 15, cancel line 1; line 2, cancel 'flux,'; same line, change "a" to —A— before the word "method"; same line before "welding" insert —electric arc—; line 3, before "re-

ducing" insert —and—; line 5, cancel "and" and insert —thereby—.

Remarks

Claim 15 has been amended to overcome the Examiner's objection.

Applicants request a reconsideration of the requirement for division.

It is noted that the Examiner believes that three separate and distinct inventions are defined by the claims presented by applicants.

Applicants contend that the method of producing the improved flux and the flux resulting from such method are inventions so closely related to one another that the claims of Groups I and II are clearly examinable in the same [fol. 1063] application. It is obvious that the procedure defined by method claims 5, 14 and 17 would be incapable of producing any other products than those defined in the claims of Group I, which are directed to the novel fluxing material. Evidently the field of search in the Patent Office would be the same respecting the subject matter of these two groups of claims.

Accordingly, the requirement for division between the claims of Group I and II is improper and should be withdrawn. In this connection, the examiner's attention is invited to the decision in ex parte Cowper-Coles, 1902 C.D. 257 wherein the Commissioner held that it was improper to require division between claims to a process of depositing zinc on metallic surfaces and claims to the article produced; also, the decision in ex parte Kilbourn et al, 1915 C.D. 40 wherein the Commissioner held that both process and article claims should be allowed in the single application before him.

The fluxing material which constitutes the subject of the claims in Groups I and II is an essential element of the welding method defined in the claims of Group III. See claim 6, for example, and compare the same with claim 1 of Group I and claim 5 of Group II. Even though the welding method, as defined in the claims of Group III might be considered as a separate invention, it would be impossible to practice such method without the improved fluxing material set forth in the first two groups of claims.

Therefore, the inventions defined in the claims of Groups I, II and III are dependent upon each other and mutually

contribute to produce a single result, i.e., the making of a welded joint; and, under the provisions of Rule 41, such inventions "may be claimed in one application."

[fol. 1064] From the foregoing remarks it will be evident that there is a very close relation between the inventions defined in the several groups of claims. Therefore, the examiner should withdraw the requirement for division and render an action on the merits of all of the claims. Before repeating any part of his requirement, the Examiner is requested to submit the question of requirement for division to the classification Examiner, as required by Rule 42.

Respectfully submitted, Lloyd T. Jones, Harry E. Kennedy and Maynard A. Rotermund, By Townsend & Loftus, Their Attorneys.

[fol. 1065] [Stamp:] Mailed Dec. 13, 1933.

260

Div. 60, Room 5896

Paper No. 4

Department of Commerce, United States Patent Office, Washington

RLS-FR

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

All communications respecting this application should give the number, date of filing, and name of the applicant.

December 13, 1933.

Please find below a communication from the Examiner in charge of this application.

Conway P. Coe, Commissioner of Patents.

Applicant: L. T. Jones et al., Ser. No. 657,836. Filed Feb. 21, 1933. For Method . . . . Welding etc.

Townsend & Loftus, 907 Crocker Bldg., San Francisco, California

Responsive to amendment filed November 17, 1933.

The question of division has been submitted to the Examiner of Classification, whose decision follows:

Division between (I) claims 1-4, 10-13, 20, 21; (II) claims 5, 14, 17; (III) claims 6-9, 16, 18, 19, is approved.

The inventions are distinct, separately classified and searched.

The requirement is hereby made *final.*

R. L. S.

R. L. Glass, Examiner.

[fol. 1066] [Stamp:] U. S. Patent Office, Jan. 5, 1934. Division 60.

[Stamp:] Mail Division, Jan. 4, '34, U. S. Patent Office.

[Stamp:] Docket Division, Jan. 6, 1934, U. S. Patent Office.

In the United States Patent Office

Div. 60, Room 5896

L. T. Jones, H. E. Kennedy and M. A. Rotermund. Method of Electric Arc Welding and a Flux Therefor. Serial No. 657,836. Filed February 21, 1933.

Power of Attorney

Accepted Jan. 8, 1934, Conway P. Coe, Commissioner.

Hon. Commissioner of Patents, Washington, D. C.

SIR:

In the matter of the above-entitled application, you are requested to recognize Charles C. Sheffler, Register No. 11032, and Eugene L. Greenewald, Register No. 3276, both of 30 East 42nd Street, New York, New York, as our attorneys with full power of substitution and revocation, to prosecute the above-entitled application, to make alterations and amendments therein, to sign the drawings, to receive the Letters Patent, to transact all business in the Patent Office and before the Courts of the District of Columbia connected with this application or with the Letters Patent resulting therefrom, and to do all lawful acts and things relative thereto. Kindly address all communications to Charles C. Scheffler.

All previous powers of attorney are hereby revoked.

Respectfully, Union Carbide and Carbon Research Laboratories, Inc., Assignee of Record, By Albert C. Connell, Secretary.

New York, N. Y. January 3, 1934.

[fol. 1067] #6

EEG.

Department of Commerce, United States Patent Office, Washington

January 9, 1934.

Charles C. Scheffler and Eugene L. Greenewald, 30 East 42nd St., New York, N. Y.

Applicant Lloyd T. Jones, Harry E. Kennedy and Maynard A. Rotermund. Serial No. 657,836. Filed Feb. 21, 1933. For —. Div. 60. Method of Electric Arc Welding and a Flux Therefor.

In this case your power of attorney has been accepted.

Respectfully, Conway P. Coe, Commissioner.

Revoking by assignee power of attorney to ——.

Townsend and Loftus, 907 Crocker Bldg., San Francisco, Calif.

[fol. 1068] [Stamp:] Mail Division, May 11, '34, U. S. Patent Office.

[Stamp:] U. S. Patent Office, May 11, 1934, Division 60.

#7. Election

In the United States Patent Office

Div. 60, Room 5896

L. T. Jones et al. Method of Electric Arc Welding and a Flux Therefor. Serial No. 657,836. Filed February 21, 1933.

Hon. Commissioner of Patents, Washington, D. C.

Sir:

In response to the Official letter of December 13, 1933, applicants hereby elect to prosecute in this application the subject matter of claims 1 to 4, inclusive, 10 to 13, inclusive, 20 and 21; and the remaining claims are retained herein under the provisions of Rule 42, last sentence.

Favorable action on the merits of the first group of claims is requested.

Respectfully submitted, Eugene L. Greenewald, Attorney for Applicants.

New York, N. Y. May 10, 1934. A:GM.

[fol. 1069] Paper No. 8

All communications respecting this application should give the serial number, date of filing and name of the applicant.

[Stamp:] Mailed Aug. 8, 1934.

Div. 3, Room 4093

JO:L

260

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

Department of Commerce, United States Patent Office, Washington

Please find below a communication from the Examiner in charge of this application.

Conway P. Coe, Commissioner of Patents.

Applicant: L. T. Jones et al. Ser. No. 657,836. Filed Feb. 21, 1933. For Method of Electric Arc Welding etc.

Charles C. Scheffler, 30 East 42nd St., New York, N. Y.

Responsive to letter of May 11, 1934.

Additional references:

Severance, 429,777, June 10, 1890, 148-26.
Jerabeck, 1,956,327, Apr. 24, 1934, 219-8.
Miller, 1,965,555, July 3, 1934, 219-8.
Woods, 1,905,081, Apr. 25, 1933, 219-8.
Lloyd, 1,599,056, Sep. 7, 1926, 219-8.5.
Hammers, 1,752,793, Apr. 1, 1930, 148-26.

Claim 1 is rejected as vague and indefinite and not in compliance with R. S. 4888. The terms basic and acid components are vague and indefinite. Furthermore, the disclosure that certain silicates are suitable for use as fluxes does not warrant such broad terminology.

Claims 2, 3, 4, 20 and 21 are similarly rejected.

Claims 2, 3 and 4 are further rejected as vague and indefinite and functional. The last two lines of these claims are vague and indefinite as well as functional. Applicant

has claimed no particular material but merely sets forth a result.

Claim 13 is similarly rejected.

Claim 11 is rejected as fully met by Severance. The pumice-stone satisfies the requirement for a metallic silicate and the salt or sal-ammoniac that for the halogen compound.

Claim 10 is rejected as not patentable over any of the above cited patents. A specification of the particular manner in which the silicate fluxing material is to be used cannot make the claim patentable.

A. Lindsey, Examiner.

G. J.

[fol. 1070] Amendment B Z

In the United States Patent Office

Div. 3, Room 4093

Jones, Kennedy & Rotermund. Method of Electric Arc Welding and a Flux Therefor. Serial No. 657,836. Filed February 21, 1933

Hon. Commissioner of Patents, Washington, D. C.

Sir:

In response to the Official letter of August 8, 1934, the above-entitled application is hereby amended as follows:

Cancel claims 1, 2, 3, 4, 10, 11, 13, 20 and 21, and insert the following in lieu thereof:

Per C

B'. 22. A finely-divided unbonded fusible electric welding composition containing a major proportion of a compound having a basic component and an acid component.

23. A finely-divided unbonded fusible electric welding composition containing a halogen compound and a major proportion of a compound having both a basic component and an acid component.

[Matter enclosed between rules erased in copy.]

24. A finely-divided unbonded fusible electric welding composition containing a major proportion of a [compound having both a basic component and an acid component],* said composition being substantially free from substances capable of evolving gas under welding conditions.

Insert C'. a ^ C'

25. A finely-divided unbonded electric welding composition containing a major proportion of a fusible [compound having both a basic component and an acid component]* and a material adapted to control the density of the welding current on the parts being welded ^.

Insert C'. ^ C'

, said composition being substantially free from substances capable of evolving gas under welding conditions

Per C.

[fol. 1071] Per C

26. A finely-divided unbonded electric welding composition containing a major proportion of a fusible compound having both a basic component and an acid component, and a material adapted to control the electric conductivity of said composition.

27. A finely-divided unbonded electric welding composition containing a major proportion of a fusible compound having both a basic component and an acid component, and a material adapted to alloy the weld metal deposited during welding.

28. A finely-divided unbonded fusible composition for use in electric welding employing a bare metal electrode as a source of weld metal, said composition containing a major proportion of metallic silicate ^.

B'. , and being substantially free from substances capable of evolving gas under welding conditions

[* Words and figures enclosed in brackets erased in copy.]
[Matter enclosed between rules erased in copy.]

29. A finely-divided unbonded fusible electric welding composition containing a halogen compound and a major proportion of metallic silicate , and being substantially free from substances capable of evolving gas under welding conditions .

Per C

---

30. A finely-divided unbonded fusible electric welding composition containing a metalic silicate and a material adapted to change the composition of the weld metal deposited during welding.

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31. A finely-divided unbonded fusible composition for use in electric welding employing a bare metal electrode as a source of weld metal, said composition containing a halogen compound and a major proportion of alkaline earth metal silicate , and being substantially free from substances capable of evolving gas under welding conditions .

Per C.

32. A finely-divided unbonded fusible electric welding composition containing a fluoride and a major proportion of an alkaline earth metal silicate.

[fol. 1072] 33. A finely-divided unbonded fusible composition for use in electric welding employing a bare metal electrode as a source of weld metal, said composition being substantially free from substances capable of evolving a detrimental quantity of gas under welding conditions and containing calcium fluoride and a major proportion of one or more alkaline earth metal silicates.

Remarks

All of the rejected claims have been withdrawn and are replaced by new claims which applicants believe to be entirely free from the criticism advanced against the cancelled claims and are also patentably distinguishable from the art of record.

[Matter enclosed between rules erased in copy.]

Applicants are unable to understand wherein there is any vagueness or indefiniteness in the terms "basic" and "acid" as applied to the components of applicants' electric welding composition. These terms are quite clear and definite in a chemical sense and particularly from the context of the specification. Applicants have disclosed a variety of compositions, such as silicates, titanates, phosphates, all of which function satisfactorily for the intended purpose. In view of this fact and the absence of anticipating art, applicants are clearly entitled to claims which are sufficiently broad to protect the various compositions embraced in their invention. If the examiner considers applicants' terminology too broad, he is requested to cite references and authority to support his rejection. Judging from applicants' knowledge and the prior art cited, the applicants were the first to discover that the compositions disclosed in the [fol. 1073] present application, e.g., compositions consisting principally of alkaline earth metal silcate in a finely-divided unbonded state, are useful as electric welding compositions in which a bare metal electrode is employed as the source of weld metal.

The statements in certain claims e.g., claims 25, 26, 27 and 29, that the present electric welding composition contains "a material adapted to control the density of the welding current"; "a material adapted to control the electrical conductivity"; "a material adapted to alloy the weld metal"; and "a material adapted to change the composition of the weld metal" are neither indefinite nor functional. Applicants have clearly disclosed compositions containing materials which perform these functions; and, in the absence of anticipating art, they are entitled to claims which satisfactorily cover these compositions.

All of the patents cited in the last Official letter, except Severance, relate to coatings for welding electrodes, in which various materials are mixed together with a binder and are applied to the surface of the electrode either by dipping the electrode into the composition or by painting the composition onto the electrode. The dipped or painted electrode is dried until the coating hardens and becomes practically unitary with the electrode. Therefore, these coatings are not *finely-divided unbonded* welding compositions, and it is evident that the patentees do not disclose applicants' invention. Obviously, the patented coating compositions could not be applied to the welding electrodes

in a finely-divided unbonded state,—it is necessary to incorporate a binder and the electrodes must be dipped or painted [fol. 1074] and then dried. Applicants avoid the expense and inconvenience of using a binder ingredient as well as the dipping and drying operations; and since the claims as now presented clearly define this important difference, they are allowable.

The composition disclosed by Severance is not an electric welding composition, nor do its ingredients correspond to those of applicants' composition, as defined by the claims now presented. The main use of the Severance welding compound is for forge welding iron and steel, and there is no suggestion that this compound is adapted for electric welding. Furthermore, the principal constituent of the Severance compound is borax of which 33 parts are used; the remaining ingredients altogether comprise 14 parts of the whole, and of these the dolomite, for which a silicate may be substituted, is only 1 part of the whole. Therefore, Severance does not disclose nor suggest an electric welding composition in which an alkaline earth metal silicate or its equivalent constitutes the major portion of the composition. Even if the content of the pumice-stone and the dolomite or silicate are considered together, such ingredients still would constitute but a minor proportion of the entire compound.

The ingredients of applicants' electric welding composition and their relative proportions are very important from a practical consideration, in electric welding with a bare metal electrode, as is clearly set forth in the present application. Therefore, the claims, as now presented, are clearly allowable since they differentiate applicants' invention from the references.

Respectfully submitted, Eugene L. Greenewald, Attorney for Applicant.

New York, N. Y., February 5, 1935. A:GM.

[fol. 1075] 260

Div. 3, Room 4093

Paper No. 10

Department of Commerce, United States Patent Office, Washington

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

All communications respecting this application should give the serial number, date of filing, and name of the applicant.

B:H

Please find below a communication from the Examiner in charge of this application.

Conway P. Coe, Commissioner of Patents.

Applicant: Lloyd T. Jones, H. E. Kennedy & M. A. Rotermund. Ser. No. 657836. Filed Feb. 21, 1933. For Method of Electric Arc Welding and a Flux therefor.

Apr. 26, 1935.

C. C. Scheffler & E. L. Greenewald, 30 East 42nd St., New York, N. Y.

In re amendment filed February 6, 1935:

Claims 22 to 27 are rejected similarly to cancelled claims 1 to 4, 20 and 21 as vague and indefinite and not in compliance with Section 4888, R. S. The claims are furthermore inaccurate since applicant's compound in its final form does not contain an acid and a base but rather contains the reaction product of these, i.e., a salt. Moreover the disclosure that certain silicates, titanates, phosphates, etc., will be effective would not warrant the recitation broadly of a salt.

Claims 22 to 31 are rejected as unpatentable over Severance, for the reason noted in such rejection of Claim 11 in the last Office action. Attention is called particularly to lines 84 to 90 in Severance. There is seen no invention in reducing the borax content given by Severance in his specific example, and having the pumice-stone constitute the major ingredient.

Claims 22 to 31 are rejected.

Claims 12, 32 and 33 may be allowed.

A. Lindsey, Examiner.

[fol. 1076] Amendment C

In the United States Patent Office

Div. 3, Room 4093

L. T. Jones, H. E. Kennedy and M. A. Rotermund. Method of Electric Arc Welding and a Flux Therefor. Serial No. 657,836. Filed February 21, 1933

Method of Electric Arc Welding and a Flux Therefor

Hon. Commissioner of Patents, Washington, D. C.

SIR:

In response to the official action of April 26, 1935, the above-entitled application is hereby amended as follows:

Cancel claims 22, 23, 26, 27, and 30.

Claims 24 and 25, lines 2 and 3 of each, cancel "compound having both a basic component and an acid component" and insert therefor:

C'. —*stable nonvolatile oxydic salt the basic component of which is selected from the oxides of the alkali and alkaline earth metals, and the acid component of which is an oxide of an element selected from the fourth, fifth, and sixth groups of the periodic classification of elements*—.

Claim 25, last line, add —, *said composition being substantially free from substances capable of evolving gas under welding conditions.*

Claims 28, 29, and 31, last line of each, add: —, *and being substantially free from substances capable of evolving gas under welding conditions.*

Remarks

The allowance of claims 12, 32, and 33 is noted. Rejected claims 22, 23, 26, 27, and 30 are cancelled. Claims 24, 25, 28, 29, and 31 are amended to overcome the objection that they are vague, indefinite, broader than the invention, and [fol. 1077] unpatentable over Severance of record, and it is believed that these claims are now allowable. Reconsideration of the claims now presented is respectfully asked.

The cited patent to Severance, No. 429,777 does not antici-

pate the present invention, because the patentee specifies as essential constituents of his flux spathic iron ore (iron carbonate) and salammoniac (ammonium chloride), both of which compounds evolve large volumes of gas at welding temperatures, thereby behaving directly contrary to the behavior of applicant's composition. No other reference of record is pertinent or has been applied to the claims.

Claims 24 and 25 are amended to specify that the compound in question is a salt, as suggested by the Examiner, and are limited to the oxydic salts of the class specifically disclosed in the specification, also as suggested by the Examiner.

Thus, the claims presented are definite, coextensive in scope with the disclosed invention, and are patentable over the art of record. Favorable action is solicited.

Respectfully submitted, Eugene L. Greenewald, Attorney for applicants.

New York, N. Y., October 22, 1935. G/K.

[fol. 1078] [Stamp:] Mailed Dec. 9, 1935.

B:G. 260

Department of Commerce, United States Patent Office, Washington

Div. 3, Room 4093

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

Paper No. 12

All communications respecting this application should give the serial number, date of filing, and name of the applicant.

Please find below a communication from the Examiner in charge of this application.

Conway P. Coe, Commissioner of Patents.

Applicant: L. T. Jones, et al. Ser. No. 657,836. Filed Feb. 21, 1933. For Method of Electric Arc Welding and Flux Therefor.

Charles C. Scheffler, 30 East 42nd St., New York, N. Y.

Responsive to amendment filed Oct. 23, 1935.

Claims 24 and 25 are again rejected as vague and indefinite and failing to point out the invention with the particularity required by Sec. 4888, R.S. The disclosure that certain silicates, titanates, etc., will be effective is not considered to warrant the assumption that all the compounds falling under the broad generalization now appearing in these claims would be effective.

Claims 24, 25, 28, 29 and 31 are again rejected as unpatentable over Severance for reasons of record. The negative limitations recited are improper and are considered patentably immaterial.

Claims 24 and 28 are further rejected as calling for an old composition, reciting a use therefor. Even if the use were new, this would not warrant a claim to the old composition as such.

Claims 24, 25, 28, 29 and 31 are rejected.

Claims 12, 32 and 33 may be allowed.

A. Lindsey, Examiner.

[fol. 1079] [Stamp:] U. S. Patent Office, May 14, 1936, Division 3.

[Stamp:] Mail Division, U. S. Patent Office, May 13, 1936.

IN THE UNITED STATES PATENT OFFICE

Div. 3, Room 4093

L. T. Jones, H. E. Kennedy and M. A. Rotermund. Method of Electric Arc Welding and a Flux Therefor. Serial No. 657,836. Filed February 21, 1933.

Formal Abandonment

To the Commissioner of Patents, Washington, D. C.

SIR:

The above-identified application, but not the invention disclosed therein, is hereby formally abandoned in favor of application Serial No. 44,142 filed October 9, 1935 by Lloyd T. Jones, Harry E. Kennedy, and Maynard A. Rotermund. The latter application contains claims directed to the invention claimed in the formal application.

The formal authorization to abandon, signed by the inventors, is filed herewith.

Respectfully, Eugene L. Greenewald, Attorney for applicants.

New York, N. Y., May 12, 1936.

Union Carbide and Carbon Research Laboratories, Inc., assignees of the above-identified application, hereby consent to the above abondonment of the said application, but not the invention disclosed therein.

Respectfully, Union Carbide and Carbon Research Laboratories, Inc. By Albert Chester Cornell, Secretary.

New York, N. Y., May 12, 1936. G/K.

[fol. 1080] In the United States Patent Office

Div. 3, Room 4093

L. T. Jones et al. Method of Electric Arc Welding and a Flux Therefor. Serial No. 657,836. Filed February 21, 1933.

Authorization to Abandon

We, Lloyd Theodore Jones, Harry Edward Kennedy, and Maynard Arthur Rotermund, of Berkeley, California, the joint inventors in the above-entitled application, hereby authorize our attorneys, Charles C. Scheffler and Eugene L. Greenewald, or either of them, formally to abandon the above identified application but not the invention disclosed therein. This authorization is made in view of the presentation in our copending application Serial No. 44,142, filed October 9, 1935, of claims directed to the invention claimed in the above-identified application.

Lloyd Theodore Jones, Harry Edward Kennedy. Maynard Arthur Rotermund.

Berkeley, California, April 10, 1936. G/K.

[fol. 1081] State of California,
County of Alameda, ss:

On this 10 day of April in the year One Thousand Nine Hundred and 36, before me, C. N. Lavers, a Notary Public in and for the County of Alameda, State of California, residing therein, duly commissioned and sworn, personally appeared Lloyd Theodore Jones, Harry Edward Kennedy, Maynard Arthur Rotermund, known to me to be the persons described in and whose names are subscribed to the within instrument, and they acknowledged to me that they executed the same.

In Witness Whereof, I have hereunto set my hand and affixed my Official Seal, the day and year in this certificate first above written.

C. N. Lavers, Notary Public in and for Said County of Alameda, State of California. (Seal)

[fols. 1082-1099] [Stamp:] Mailed May 15, 1936.

260

B:G.

Department of Commerce, United States Patent Office, Washington

Div. 3, Room 4093

Paper. No. 14

All communications respecting this application should give the serial number, date of filing, and name of the applicant.

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

Please find below a communication from the Examiner in charge of this application.

Conway P. Coe, Commissioner of Patents.

Applicant: Jones, et al. Ser. No. 657,836. Filed Feb. 21, 1933. For Method of Electric Arc Welding and a Flux Therefor.

Charles C. Scheffler, 30 East 42nd Street, New York, N. Y.

In re letter of formal abandonment and authorization therefor, filed May 13, 1936.

The above letter of formal abandonment and authorization therefore have been entered.

In accordance therewith, this application will be sent to the abandoned files in due course.

A. Lindsey, Examiner.

[fol. 1100] PLAINTIFF'S EXHIBIT 126

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Department of Commerce
United States Patent Office

To all persons to whom these presents shall come, Greeting: This is to certify that the annexed is a true copy from the records of this office of the File Wrapper and Contents, in the matter of the Abandoned Application of Lloyd T. Jones, Harry E. Kennedy and Maynard A. Rotermund, Filed January 9, 1934, Serial Number 705,892, for Improvement in Electric Welding.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington, this fourth day of October, in the year of our Lord one thousand nine hundred and forty-five and of the Independence of the United States of America the one hundred and seventieth.

Attest: T. A. Coulter, Acting Chief of Division.
Casper W. Ooms, Commissioner of Patents. (Seal.)

(Here follows 1 Photolithograph, side folio 1101)

[fol. 1113] 9. A resistive composition for electric welding which is conductive when fused and which comprises alkaline earth metal silicate.

10. A resistive composition for electric welding which is conductive when fused and which comprises an alkaline earth metal silicate and an alkaline earth metal fluoride.

Add A[4].

[fol. 1114] In Testimony Whereof, we affix our signatures.

(S.) Lloyd T. Jones, Harry E. Kennedy, Maynard A. Rotermund.

Oath

County of Alameda,
State of California, ss:

Lloyd T. Jones, Harry E. Kennedy and Maynard A. Rotermund the above named petitioners, being duly sworn, depose and say that they are citizens of the United States and residents of Berkeley, California, that they verily believe themselves to be the original, first and joint inventors of the Improvements in Electric Welding, described and claimed in the annexed specification; that they do not know and do not believe that the same was ever known or used before their invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by them or their legal representatives or assigns more than twelve months prior to this application; and that no application for patent on said improvements has been filed by them or their legal representatives or assigns in any country foreign to the United States.

(S.) Lloyd T. Jones, Harry E. Kennedy, Maynard A. Rotermund.

Sworn to and subscribed before me this 2 day of January, 1934. L. F. Macdonald, Notary Public, Alameda County, Calif. (Seal.)

[Matter between rules cancelled in copy.]

[fol. 1115] [Stamp:] Mailed May 4, 1934

260

Div. 60, Room 5896
Paper No. 2

Department of Commerce, United States Patent Office,
Washington

RLS-FR

Address only: "The Commissioner of Patents, Washington, D. C.," and not any official by name.

All communications respecting this application should give the serial number, date of filing, and name of the applicant.

May 4, 1934.

Please find below a communication from the Examiner in charge of this application.

Conway P. Coe, Commissioner of Patents.

Applicant: L. T. Jones et al., Ser. No. 705,892. Filed Jan. 9, 1934. For Electric Welding.

Charles C. Scheffler, 30 E. 42nd St., New York, N. Y.

This case has been examined.

Reference made of record: Robinoff, 1,782,316, Nov. 18, 1930, 219-10-67.

Claims 1 to 7 are each rejected as fully met by Robinoff. Recitation that (claims 3 to 6) a flux of a particular kind is utilized does not alter the process.

Claims 8 to 10 are each rejected for failure to comply with Section 4888 R. S. in that said claims *define* naught. For example, the applicant does not teach that just any composition which is conductive when fused and incapable of evolving gases will be of utility (claim 8). Further he does not teach that an alkaline earth and metal silicate and/or an alkaline earth metal fluoride in pure form or in just any proportion of a combination is efficacious.

Claims 8 to 10 are each further rejected as admittedly old (paragraph beginning on page 2 of specification).

No claim is allowed.

R. L. Glass, Examiner.

R. L. S.

NUMBER (Series of '1925)

705892

PATENT NO.

1934

DATED

DIV. 1 1

(EX'R'S BOOK) 6-70

Name LLOYD T. JONES, HARRY E. KENNEDY AND MAYNARD A. ROTERMUND

[illegible]

This appl[illegible]

Patent No. 2043406

Do not dest[illegible] Ser. No.

of BERKELEY

State of CALIFORNIA

3166, 400 O.G.

Invention

ELECTRIC WELDING

DO NOT DETACH

, 19 , filed

APPLICATION FILED

ORIGINAL

APPLICATION FILED COMPLETE JAN 9, 1934

Petition, Specification, Oath, First Fee $30, ~~sheets Drawings~~, JAN 9, 1934

RENEWED

ORIGINAL

APPLICATION FILED COMPLETE JAN 9, 1934

Petition, Specification, Oath, First Fee $30, ~~sheets Drawings~~, JAN 9, 1934

RENEWED

PARTS OF APPLICATION FILED

Division of App., No. , filed

Examined and passed for Issue Nov. 11, 1935

R. L. Glass Exr. Div. 60

Notice of Allowance [illegible] 1935

By Commissioner.

Final Fee , 193

Reexam'd and passed for Issue , 193

Exr. Div.

Notice of Allowance , 193

By Commissioner.

Final Fee , 193

Attorney CHARLES C. SCHEFFLER & EUGENE L. GREENEWALD 30 EAST 42ND ST NEW YORK N Y.

Associate Attorney

No. of Claims Allowed 14 Print Claims 1, 6 in O. G. Class 21-2

Title as Allowed Electric Welding

1101

10214

[fol. 1116] IN THE UNITED STATES PATENT OFFICE

Div. 60, Room 5896

L. T. Jones, et al.

Electric Welding

Serial No. 705,892

Filed January 9, 1934

Hon. Commissioner of Patents, Washington, D. C.

SIR:

Applicants have carefully considered the Official letter of May 4, 1934 in the above-entitled application; and request that the following amendment be entered:

In the specification, page 4, line 2, for "the arc process" substitute—*prior arc processes*—; line 3, after "all" insert —*prior*—; line 3, cancel "and uses no arc"; line 13, correct the spelling of "efficacious".

Page 5, line 1, for "$CaCO_3$" substitute—*calcium carbonate*—; line 2, for "MgO" substitute—*magnesium oxide*—; line 2, for "SiO_2" substitute—*silica*—.

Page 8, line 6 and line 11, after "arc" in each instance insert—*of the usual type*—.

Claim 1, line 2, after "melt" insert—

A[1]. , *containing a major proportion of alkaline earth metal silicate and substantially free from uncombined iron oxide*,—.

Claim 2, line 4, after "melt" insert

A[2]. —*containing a major proportion of alkaline earth metal silicate and substantially free from uncombined iron oxide*—.

Claims 3 and 4, line 4 of each, after "silicate" insert—*substantially free from uncombined iron oxide*—.

Claim 7, line 4, after "melt" (first occurrence) insert—

A[3]. *containing a major proportion of alkaline earth metal silicate and substantially free from uncombined iron oxide*—.

[fol. 1117] Cancel claims 8, 9, and 10, and rewrite them as follows:

A⁴. 8 [11]*. A composition for electric welding containing a major proportion of alkaline earth metal silicate, and being substantially free from uncombined iron oxide and from substances capable of evolving gases under welding conditions.

9 [12]*. A composition for electric welding containing a major proportion of calcium silicate, and being substantially free from uncombined iron oxide and from substances capable of evolving gases under welding conditions.

10 [13]*. A composition for electric welding containing a fluoride and a major proportion of alkaline earth metal silicate, and being substantially free from uncombined iron oxide and from substances capable of evolving gases under welding conditions.

11 [14]*. A composition for electric welding containing a fluoride and a major proportion of calcium silicate and being substantially free from uncombined iron oxide and from substances capable of evolving gases under welding conditions.

12 [15]*. A composition for electric welding comprising fluorspar, magnesium silicate, and calcium silicate, the latter silicate being present in predominant proportion.

Remarks

The examiner's holding is based on an erroneous postulate, viz., that altering the welding composition or "flux" of the reference does not produce a new process. That such a change can result in a new process is clear from well established practice with respect to process patents. If a [fol. 1118] series of manipulations, old in themselves, are performed with or on a material not previously used with these manipulations, and a new result follows, there is a new and patentable process.

Before making the present invention, applicants were familiar with the process of the Robinoff et al. patent, hav-

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[* Words and figures enclosed in brackets erased in copy.]

[fol. 1102] UNION CARBIDE AND CARBON RESEARCH LABORATORIES, INC.

Carbide and Carbon Building
30 East Forty-Second Street

Patent Department

New York, January 8, 1934

Commissioner of Patents, Washington, D. C.

SIR:

We enclose herewith Union Carbide Company check No. 171148 for Thirty Dollars ($30.00) to your order to cover the filing fee in the following application, executed petition, application and oath of which are attached hereto:

Inventors: Lloyd T. Jones, Harry E. Kennedy and Maynard A. Rotermund.
Title: Electric Welding.
Executed: January 2, 1934.

We would appreciate promptly receiving the filing receipt for this case, for use in connection with the filing of corresponding foreign patent applications.

Very truly yours,

Patent Department, E. L. Greenewald.

ELG:GM. Encl.

[fol. 1103] PETITION FOR UNITED STATES LETTERS PATENT

To the Commissioner of Patents of the United States of America:

Your petitioners, Lloyd T. Jones, Harry E. Kennedy, and Maynard A. Rotermund, citizens of the United States, residing at Berkeley in the County of Alameda and State of California, P. O. Address: 896 Santa Barbara Road; 105 Tunnel Road; 479 Kentucky Avenue, Berkeley, California, respectively, pray that Letters Patent may be granted to them, for Improvements in Electric Welding set forth in the annexed specification; and they hereby appoint Charles C. Scheffler, Register No. 11032, and Eugene L. Greenewald, Register No. 3276, both of 30 East 42nd Street, New York, New York, their attorneys with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to

sign their names to the drawings, to receive the Letters Patent, and to transact all business in the United States Patent Office connected therewith, the said power to be exercised either separately or collectively by said attorneys as they shall from time to time elect. Please address all communications to Charles C. Scheffler.

Signed at Albany, California, in the County of Alameda and State of California the second day of January, 1934.

(Sign here First name in full.) Lloyd T. Jones, Harry E. Kennedy, Maynard A. Rotermund.

Specification

To All Whom It May Concern:

Be it known that We, Lloyd T. Jones, Harry E. Kennedy and Maynard A. Rotermund, citizens of the United States, residing at Berkeley in the County of Alameda and State of California, have invented certain new and useful Improvements in Electric Welding of which the following is a specification:

[fol. 1104] This invention relates to electric welding.

Among the various ways in which electrical energy has been converted into heat for the welding of metals, the arc process (which itself takes several forms) is the most generally practiced. A typical example of arc-welding is its use to join the abutting edges of steel plates. In the metal-arc variation of the arc process, molten metal, provided by the melting of a metal wire or rod of suitable composition, is introduced between the abutting edges of the plates, and the latter are fused sufficiently to permit the added metal to coalesce with the metal of the plates, so that, on cooling, a structurally strong bond results. The requisite heat is developed, as the term "arc process" implies, by maintaining either a direct current or an alternating arc between the parts to be welded, connected to one side of the power line, and the wire or rod used to supply the molten metal, connected to the other side of the power line. The abutting plate edges are usually beveled to form a trough for receiving the molten metal, thereby facilitating coalescence of the added metal with the plates throughout the thickness of the latter.

In metal-arc welding it is customary to protect the freshly deposited molten metal with a blanket of molten metal

ing had practical experience with that process in numerous efforts to make it operate satisfactorily. They never succeeded; and their failure with the patented process impelled them to pursue the researches which led to the present invention.

The patented process uses a flux which apparently contains a plurality of substances, although but one is specifically mentioned in the patent. The disclosures of the patent, in this respect, does not extend beyond the content of a single sentence,—"The groove is then filled with a powdered flux composition having a percentage of ground or powdered scale (ferrous oxide) to make the flux magnetizable". (Page 1, lines 40-44). According to applicants' information, in the Robinoff et al. process as actually used by the patentees and their assignees, a mixture of iron oxide and clay is used. Applicants have extensively tested that combination, and have also tested mixtures of iron oxide with other fluxing substances.

Applicants believe that no one has obtained better results with the patented process than applicants themselves have obtained. They found that the patented process is, as the patent repeatedly states, an arc process. The dazzling arc characteristic of conventional arc-welding processes, is always in evidence. They found that currents in excess of about 900 amperes can not be successfully used, nor can [fol. 1119] plates more than about 3/8 inch thick be successfully welded in a single pass. They also found that the deposited metal lacks homogeneity, and that the powdered flux is blown about to such an extent that it becomes exceedingly offensive to the operator and any others near the job.

Seeking the causes of these defects, applicants found that the iron oxide (which presumably loses all magnetic properties as soon as melted) is not only quite unnecessary, but highly objectionable. They omitted the iron oxide entirely, and compounded a mixture composed of materials of which not a single one is even mentioned in the patent, and finally emerged with a process in which no arc, nor even any red-hot material, is ordinarily visible; in which there is no puffing of the flux; in which the current and plate thickness (weldable at a single pass) can reach any values for which there is a commercial demand, for example 2600

[* Words and figures enclosed in brackets erased in copy.]

compounds (usually compounds of the alkali or alkaline earth metals), and the material used for forming this blanket is called the "flux". The usual method of providing a flux blanket on the weld is to encase the welding rod or wire (usually referred to as the electrode) in an adherent sheath of solid flux, and this gives rise to further difficulties. The sheath is fragile as a rule and is, moreover, non-con- [fol. 1105] ductive when cold, so that electrical connection must be made with the electrode at points bared for that purpose, and at variable distances from the weld, thereby imposing an additional burden on the automatic regulating devices used in machine welding.

For good welding a homogeneous deposit of metal is indispensable. In metal-arc welding it is found that the difficulties involved in securing a homogeneous deposit are multiplied as the thickness of the deposit increases, so that, if thick plates are to be welded, it becomes necessary to make several traverses or "passes", adding a layer of metal each time until the necessary thickness is attained. This method of operation is obviously time-consuming, the more so since it is usually necessary to chip off the cover of solidified flux on one deposit, and peen the metal, before another deposit can be superimposed. It also complicates the stresses set up by contraction of the metal in the cooling weld, and the resulting distortion of the welded parts.

An object of the present invention is to avoid the disadvantageous features cited above, and to provide a process by which thick plates can be strongly and rapidly electrically welded in a single pass. Another object is to provide a process in which heavier welding currents can be used, thus accelerating the rate of welding. A further object is to overcome the difficulties which, in prior processes, are caused by the inherent instability of an electric arc, its liability to be extinguished by a variety of adventitious causes, and the difficulty, especially in automatic machines, of reestablishing the arc when it has been extinguished. Another object is to avoid the necessity for a flux sheath on the electrode. Other objects of the invention will become apparent as the description of our invention proceeds.

amperes and two-inch plates,—neither of these values being limits; and in which the deposited metal is absolutely sound and homogeneous. Yet the examiner says that what they did "does not alter the process".

Applicants' specification has been slightly amended where it discusses the theory of their process, and compares this process with prior arc processes. It is immaterial to the patentability of the invention whether applicants are able to give the correct theory or not, but it is their purpose to give the examiner the fullest information in their possession on this matter. It is difficult, if not impossible, to define an arc precisely, and applicants have contemplated the possibility that a definition may be framed in such terms as to embrace the phen[on]*omenon which occurs in their [fol. 1120] process. There can be no question, however, that there is no such arc involved in their process as occurs in every prior arc process, including that of Robinoff et al. Anyone, if he bears in mind the intense dazzling arc which less than fifty amperes will evoke and stands by one of applicants' machines and sees a weld made with two thousand amperes but with little or no visible evidence that a heating operation is being carried on, will quickly be convinced that here is something quite different from any arc welding process known to the art.

At the top of page 5 certain chemical formulas have been replaced by the corresponding names to rebut any presumption, however improper in view of the context, that the substances used in the specific example were chemically pure. As clearly appears from the context the calcium carbonate, magnesium oxide and silica used were merely of a good *technical* grade.

Several of the process claims have been amended and the composition-of-matter claims have been rewritten. Since the use in the process of a composition which brings about a new result clearly gives rise to a new and patentable process, it is only necessary in the process claims, to recite those characteristics of the composition which are responsible for the new result. These characteristics are, briefly, a high content of *alkaline earth metal silicate*, and *substantial absence of uncombined iron oxide*. Robinoff et al.

[* Words and figures enclosed in brackets erased in copy.]

[fol. 1106] We have discovered a novel process of welding
prior arc processes
Per A which resembles ∧ [the arc process]* in many ways
prior
" A but which is essentially different from all ∧ arc processes [and uses no arc].* As in prior processes the necessary heat is generated in our process by causing a heavy electrical current to flow across a region of relatively high electrical resistance, and thence to a member onto which metal is to be deposited, but in our process the resistance is provided, not by a body of ionized gas, but by a conductive melt.

The conductive melt used in our process doubtless performs the protective functions of a flux, but it is much more than a flux and many compositions which are satisfactory fluxes for arc welding are unsuitable for our purpose.
efficacious
Per A While other melts are more or less ∧ [efficaceous]* in our process, we prefer silicates of the alkaline earth metals, such as calcium silicate, and in many cases we prefer to add to these silicates a minor proportion of a substance adapted to lower the melting point, for example, a halide salt. We have had excellent results with a material corresponding closely to the composition represented by the formula $RO.SiO_2$ where R stands for calcium or magnesium, but silicates which are more acid or more basic are also suitable. We have also used manganese silicates, especially in conjunction with other silicates, and it is probable that alumina-containing compositions may also be used in certain cases, although we have not tested them extensively, the calcium and magnesium silicates being cheap and entirely satisfactory. When more fluidity is desired the more acid silicates may be used, but we prefer to control the fluidity by additions of alkali metal compounds and halides, especially fluorspar. Good results have been obtained by adding about 6% fluorspar to an alkaline earth metal silicate. Boron compounds in large proportion do not appear to be advantageous, and so far as our researches have extended, the results obtained with iron-bearing silicates have not been satisfactory.

Fluorspar $=CaF_2$

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seem to have been the only workers prior to applicants who, in an electric welding process, began operations by filling the seam with a fusible non-metallic composition; and the composition of Robinoff et al. differed from that of applicants, as now defined, in every respect.

[fol. 1121] The objection to claims 8, 9 and 10 seems to have been unwarranted. As clearly appears from the specification there is a wide range within which the composition of the welding material may be varied. Applicants see no reason why the examiner should question the operativeness of any composition falling within these claims as rewritten. Applicants have made no admission that the compositions of claims 11 to 14 inclusive are old. Compounds of alkali and alkaline earth metals have indeed been used as fluxes. That claims 11 to 15 are limited so as to distinguish from this statement is too obvious to require further discussion.

Reconsideration, in view of the foregoing amendments and arguments, is asked.

Respectfully submitted, Eugene L. Greenewald, Attorney for Applicants.

New York, N. Y., November 1, 1934.

A:GM

[fol. 1122] Paper No. 4

[Stamp:] Mailed Dec. 8, 1934.

260

Div. 60, Room 5896

Department of Commerce, United States Patent Office, Washington

RLS-FR

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

All communcations respecting this application should give the serial number, date of filing, and name of the applicant.

December 8, 1934.

Please find below a communication from the Examiner in charge of this application.

Conway P. Coe, Commissioner of Patents.

[fol. 1107] In a specific instance we fused together 50 calcium carbonate magnesium oxide
Per A pounds of $_{\wedge}$ [$CaCO_3$],* 9.4 pounds of $_{\wedge}$ [MgO],* and silica
" A 40.5 pounds of $_{\wedge}$ [SiO_2] * until the reaction was complete. The materials used were of the purest quality used in the ceramic industries. The fused material was cooled and granulated, and to each pound, one ounce of fluorspar was added. The material was then ready for use to form the conductive melt which is the principal feature of our process.

In practicing our process the plates to be welded are arranged as for arc welding. The edges are preferably beveled but this is less necessary than with arc welding because the "penetration" and width of the weld, which depend on the extent to which the edges of the plates are fused during the welding, can be more closely controlled in our process. The usual copper "backing-up" strip is preferably used.

When a weld is to be made between beveled edges the operation is started by filling the groove with the resistive composition, preferably in powdered or granular form, and a suitable additional quantity of the composition is heaped up along the groove. If the plates are not beveled the procedure is the same, except that a larger proportion of the composition will usually be above the upper surface of the plates, that is, outside of the seam itself.

The material placed in and on the groove is preferably stable at the welding temperature in the sense that it does not evolve detrimental volumes of gases when brought to that temperature. Thus if, instead of preformed calcium silicate, a mere mechanical mixture of calcium carbonate and silica were placed in the groove and the weld started, carbon dioxide would be evolved from the calcium carbonate, and the development of a conductive melt would be delayed and irregular. The resistive composition should also be substantially anhydrous. After the weld is finished the resistive composition can be collected and reused, any volatile constituents lost, such as halides, being of course replaced.

When our process is used to deposit metal from a metal [fol. 1108] electrode, the tip of the latter is dipped into the

* Struck out in Copy.

Applicant: Lloyd T. Jones et al., Ser. No. 705,892. Filed Jan. 9, 1934. For Electric Welding.

Charles C. Scheffler, 30 E. 42nd St., New York, N. Y.

Responsive to amendment filed November 2, 1934.

References made of record:

Severance, 429,777, June 10, 1890, 148-26.
Hammers, 1,752,793, Apr. 1, 1930, 148-26.

Division is required. Thus:

I. Claims 1 to 7 which recite a process of welding.

II. Claims 11 to 15 which recite a welding composition or flux.

The art cited together with the art of record indicate distinctness of classification of the two inventions. Further, the process of group I may be practiced with fluxes other than that of group II and other processes of welding than that of group I may utilize the flux of group II.

The foregoing requirement is along a line identical to that for requirement of division in Serial No. 657,836 of which this case is an alleged continuation-in-part. In that case the requirement was approved by the Classification Examiner. The requirement herein is thought also proper.

Action on the merits of the claims awaits applicant's election.

R. L. Glass, Examiner.

R. L. S.

[fol. 1123] [Stamp:] U. S. Patent Office, Feb. 6, 1935. Division 60.

[Stamp:] Mail Division, Feb. 6, '35, U. S. Patent Office.

In the United States Patent Office

Div. 60, Room 5896

L. T. Jones et al., Electric Welding, Serial No. 705,892. Filed January 9, 1934.

Hon. Commissioner of Patents, Washington, D. C.

Sir:

In response to the Official letter of December 8, 1934. Applicants contend that the requirement of division is

resistive composition, a low-resistance path is provided, for example by bridging the gap between the electrode and the seam with a sliver of graphite, and the power is applied. The composition is soon locally heated until it fuses and becomes conductive, and immediately thereafter the end of the electrode begins to fuse and the molten metal begins to deposit in the groove. At the same time the edges of the plates begin to fuse and coalesce with the deposited metal. The electrode is then fed toward the seam and moved along the seam at appropriate rates, preferably by a mechanical device not unlike those which are now extensively used for arc-welding, and the weld proceeds without interruption. There is no puffing or displacement of the melt, no sparking, and indeed scarcely any external evidence that a weld is being made. The weld is ordinarily completed in one pass, even in thick plates, but a plurality of deposits, either on the same or opposite sides of the plates, are not precluded. The resistive composition in front of the electrode remains unfused, while the fused material rises to the top of the completed portion of the weld and solidifies with the metal. Even this effect is scarcely visible because of the use of an excess of the resistive composition which remains unfused and covers the fused material and the metal.

The results attained are, as in arc-welding, influenced by the potential or voltage difference between the electrode and the seam, by the magnitude of the welding current, by the size of the electrode, and by the rates at which the electrode is fed toward the seam, and traversed along the seam. Assuming a constant welding speed, the welding voltage and current vary with the plate thickness, each being a function thereof. For example, we may use a welding voltage of about 36 volts and a welding current of about 1500 amperes when welding together steel plates about one inch thick using a welding rod about 3/8 inches in diameter and a welding speed along the seam of about eight inches per minute. The welding current, which is preferably alternating, may rise to 2000 amperes or more, many of our experimental welds in thick plate (for example 1.5 inches) having been made with a current of 1600 [fol. 1109] amperes. Such thick plate can be readily welded at the rate of 6 or 7 inches per minute. A current of 2000 amperes may be used with electrodes only 0.50 inches in diameter, or even smaller; while with lower current proportionately smaller electrodes may be used.

improper and should be withdrawn because there is such a close relation and interdependence between the subject matter of claims 1 to 7, inclusive, and the subject matter of claims 11 to 15, inclusive, that all of these claims are properly examinable in a single application under the provisions of Rule 41.

The examiner obviously is in error in assuming that "the process of group I may be practiced with fluxes other than that of group II". Each claim in group I plainly includes a welding composition of the kind defined in the group II claims. That is to say, the welding composition is an essential feature of the welding process, — the successful functioning of applicants' welding process and its novelty are dependent upon the particular welding composition used. Applicants have disclosed no other process in which these welding compositons can be used; and whether or not they could be used in other processes is quite irrelevant here. The fact remains that the welding processes defined in claims 1 to 7, inclusive, specify welding compositions of the kind defined in claims 11 to 15, inclusive; and therefore these two groups of claims and the invention defined thereby are so closely related that they belong in and should [fol. 1124] be examined in the same application.

The mere fact that there are separate Office classifications for welding processes and for welding compositions is not in and of itself a sufficient reason for splitting up every set of claims in the manner proposed by the examiner in this application. The examination of these two groups of claims in a single application will not impose any extra burden upon the Office or the examiner because it is evident from the wording of the claims that the fields of search for the process claims and for the composition claims must of necessity be practically the same in order to be complete.

Applicants still believe that the requirement of division in their application Serial No. 657,836 was improper, and the ruling in that case does not apply here. From a careful comparison it will be evident that the claims in the earlier application are worded quite differently from those here under consideration. If the foregoing discussion of this matter does not change the examiner's opinion, he is requested to submit this matter to the Classification Examiner for review, and we are confident that the latter will recognize the propriety of applicants' contention and the

The resistive compositions for which a preference has been expressed herein give, in general, a satisfactory degree of "penetration", or melting of the members onto which the deposit is being made. If it is desired to vary the degree of penetration, we have found that some control of this feature can be achieved by varying the fusibility and conductivity of the resistive composition. While we are unable, at the present stage of our researches, to lay down comprehensive rules with respect to this matter, we believe the proper course to pursue in order to effect a given change in penetration with a given resistive composition will be determinable by a skilled welder without undue difficulty. As an example of the possibilities in this direction it may be remarked that fluorspar additions to silicate compositions often serve to diminish the penetration from an otherwise objectionably high degree. While the effect of the fluorspar appears to be merely to increase the fusibility, it may be much more complex, and we do not restrict ourselves to any particular theory of operation.

Welds made by our process have certain distinguishing characteristics. In many cases the planes defining the ultimate zone of fusion at the sides of the weld are approximately parallel, and this relation obtains whether the parts are preliminarily beveled to a wide V, to a narrow V, or are not beveled at all. The deposit of metal occurs, not directly under the electrode, but back of it, and there appear to be liquid currents (possibly caused by the so-called "pinch effect") which cause the surface of the resistive composition to be depressed at the point where it is first fused, that is, just ahead of the electrode, and cause both the deposited metal and the conductive melt to be heaped [fol. 1110] up back of the electrode. This facilitates the production of a weld having the desirable upwardly convex surface, with some excess metal above the seam, which can either be machined off or, as in the usual practice, left for reinforcement.

Several circumstances show clearly that our process does
Per A not depend on the formation of an arc $\wedge$ of the usual type. If, while a weld is being made, the circuit is opened externally of the weld and then closed again while the resistive composition is still molten, the current will immediately resume its flow without any necessity for moving the electrode into con-

very close relation between the present groups of claims which may not have been so clear to him when considering the claims of application Serial No. 657,836. As having a further bearing upon this question, applicants submit below the numbers of a few patents selected at random and in which the Patent Office has allowed in a single patent claims to a process of welding as well as claims to a material used in the welding process:

Patent No.	Date	Name	Title

1,613,942, 1-11-1927, R. D. Davies, Process of Facing the Cutting Edges of Drilling Tools.

[fol. 1125]

1,840,921, 1-12-1932, H. L. Spence, Bronze for Welding.

1,966,260, 7-10-1934, E. L. Munson, Copper Alloy Welding Rod and Method of Using the Same.

1,967,872, 7-24-1934, G. E. Doan, Welding Electrode.

1,974,436, 9-25-1934, W. K. Schweitzer, Flux for Use in Soldering.

1,977,128, 10-16-1934, F. P. Hawkins, Hard Facing.

In Patent No. 1,966,260, for example, the Office has allowed the following claims in a single patent:

"3. The method of welding metals which comprises adding to the weld a copper base alloy including barium in amount from approximately 0.10 percent to 1.0 percent."

"4. A welding or filler rod comprising a copper base alloy including barium in amount from about 0.10 percent to about 1.0 percent."

Again, in patent No. 1,974,436 the Office has allowed the following claims in a single patent:

"7. A flux for soft soldering metals comprising zinc chloride, alcohol, and cetyl ammonium sulfate."

"14. In a process of soft soldering, the step of applying a flux comprising zinc chloride, alcohol, and cetyl ammonium sulfate."

Again in patent No. 1,977,128, the Patent Office allowed the following claims in a single patent:

tact with the seam as it would be necessary to do to reestab-
of the usual type
Per A lish an arc ∧. The heat for melting the electrode is evidently developed in the conductive melt itself.

This application is a continuation-in-part of our copending application Serial No. 657,836, filed February 21, 1933.

[fol. 1111] We Claim:

1. A process of electric welding which comprises the step of forming a conductive high-
Insert A^1 resistance melt ∧ on a metal part to be fused,
A^1
and passing an electric current through a circuit comprising said melt and said metal part.

2. A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a con-
Insert A^2 ductive path of high-resistance melt ∧; and passing
A^2
along said conductive path an electric current of sufficient magnitude to maintain the conductivity, progressively melt the said electrode and cause the resulting molten metal to coalesce with said member.

3. A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive melt of fusible
substantially free from
uncombined iron oxide
Insert A silicate ∧; and passing through said melt an electric current of sufficient magnitude to maintain the conductivity, progressively melt the said electrode and cause the resulting molten metal to coalesce with said member.

4. A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive melt of an
substantially free from
uncombined iron oxide
Insert A alkaline earth metal silicate ∧; and passing through said melt an electric current of sufficient

"1. Composite welding rod comprising comminuted hard metal secured to one surface of a strip of softer metal."

"8. Method of welding which comprises juxtaposing a metal surface and the hard-metal surface of a welding rod consisting of a soft metal strip having hard metal on one of its surfaces, and applying a welding heat to the soft-metal surface of said strip."

In his "General Discussion of the Subject of Division" in Volume I of the Journal of the Patent Office Society, at page 411, Mr. C. H. Pierce, Law Examiner, clearly expressed the proper attitude on this question, and we quote the fol-
[fol. 1126] lowing from this article:

"A too rigid, technical and analytical dissection of applications often proves harassing and discouraging to the inventor, does not in the end save any work in the Office, and tends to prevent instead of furthering the purpose of the law, nor has it any value to the public, and it has been repeatedly condemned by the courts."

Withdrawal of the requirement of division and favorable consideration of all of the claims are solicited.

Respectfully submitted, Eugene L. Greenewald, Attorney for Applicants.

New York, N. Y., February 5, 1935.

A:GM

[fol. 1127] [Stamp:] Mailed Mar. 23, 1935.

260

Div. 60, Room 5896

Paper No. 6

Department of Commerce, United States Patent Office, Washington

RLS-FR

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

magnitude to maintain the conductivity, progressively melt the said electrode and cause the resulting molten metal to coalesce with said member.

[fol. 1112] 5. A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive melt of fusible silicate, substantially free from substances capable of evolving gases when fused in contact with the metal to be deposited; and passing through said melt an electric current of sufficient magnitude to maintain the conductivity, progressively melt the said electrode and cause the resulting molten metal to coalesce with said member.

6. A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive melt comprising an alkaline earth metal silicate and an alkaline earth metal fluoride; and passing through said melt an electric current of sufficient magnitude to maintain the conductivity, progressively melt the said electrode and cause the resulting molten metal to coalesce with said member.

7. A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive melt $\wedge^{A^3}$; passing electric current through said melt to maintain the conductivity and progressively melt said electrode; and moving said electrode along said member while maintaining the current and the conductive melt therebetween.

Insert A^3

Cancelled Per A

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8. A resistive composition for electric welding which is conductive when fused and which is substantially free from substances capable of evolving gases under welding conditions.

[Matter enclosed between rules erased in copy.]

All communications respecting this application should give the serial number, date of filing, and name of the applicant.

March 23, 1935.

Please find below a communication from the Examiner in charge of this application.

Conway P. Coe, Commissioner of Patents.

Applicant: L. T. Jones et al., Ser. No. 705,892. Filed Jan. 9, 1934. For Electric Welding.

Charles C. Scheffler, 30 East 42nd St., New York, N. Y.

Responsive to letter filed February 6, 1935.

References added to the record:——

Vervalt, 720,300, Feb. 10, 1903, 148-26.
Farrel, 111,114, Jan. 24, 1871, 148-26.
Whitcomb, 277,393, May 8, 1883, 148-26.
Miller, 1,978,318, Oct. 23, 1934, 148-26.
Original application filed Sept. 1, 1932.

The question of division herein has been submitted to the Examiner of Classification, whose decision follows:——

Division between (I) claims 1-7 and (II) claims 11-15 is not approved.

From an inspection of the record, it appears that the novelty, if any, in the process is due to the particular composition used.

Under such circumstances, the composition per se is not divisible from the method in which it is used.

Claims 8 to 10 have been cancelled.

Claims 1 to 7 are each again rejected as fully anticipated by Robinoff. As previously stated, recitation that a particular kind of flux is utilized does not alter the process. The technique involved appears to be varied in no respect whatever. The invention appears to be in the flux per se and not in a new process which is conventional welding in which that flux is used. The situation appears to be that involved in ex parte Donnell, 1923 C D 54 and the above quoted decision of the Examiner of Classification appears to share this view.

An Official search has been made of fluxes, 148-26, and the above cited references considered in connection with claims 11 to 15. Claims 11 to 15 are allowed.

R. L. S.

R. L. Glass, Examiner.

[fol. 1128] [Stamp:] U. S. Patent Office, Sep. 20, 1935. Division 60.

[Stamp:] Mail Division, Sep. 20, 1935. U. S. Patent Office.

In the United States Patent Office

Div. 60, Room 5896

L. T. Jones, et al., Electric Welding, Serial No. 705,892. Filed January 9, 1934.

Hon. Commissioner of Patents, Washington, D. C.

Sir:

In response to the Official letter of March 23, 1935, reconsideration and allowance of the rejected claims is respectfully requested.

Applicants insist that the Robinoff, et al., patent does not anticipate their welding process as defined in claims 1 to 7, inclusive.

The Examiner has recognized the novelty of the welding composition used in the present process. By using this new composition, applicants have overcome the objectionable features inherent in the Robinoff et al., process and have produced a welded joint which differs structurally from and is superior to the joint produced by the Robinoff et al., process. The Examiner is asked to read again the "Remarks" accompanying applicants' amendment filed November 2, 1934 in which we have fully explained the defects and limitations of the Robinoff process and the new and superior results of the present process as well as the decided differences in operation of these two processes. Superficially, the technique of the two processes seems to be similar but when operated side by side their performance of the welding function is very different which accounts for the superior results obtained by applicants. The new composition radically alters the conditions during the welding operation.

[fol. 1129] Substantially no gas is evolved in the welding zone and as a result a sound homogeneous joint is produced. There is no substantial gas-conducted arc, and therefore no arc-blowing, no cloud of fumes, and no such noise, heat, or blinding glare as is encountered in the Robinoff process. Current densities far beyond those practicable in the Robinoff et al., process have been used in applicants' process, and as a result far more metal can be deposited in a given time, higher welding speeds are obtainable, and thicker plates may be satisfactorily welded. These and numerous other facts heretofore presented in the specification and in previous discussions of record fully establish that applicants' process is readily distinguishable from the Robinoff et al process.

We submit that the Examiner has misinterpreted the decision of the Examiner of Classification. The latter merely decided the question of division. His statement that: "It appears that the novelty, if any, in the process is due to the particular composition used" does not mean that the process is unpatentable nor can it be construed to mean that the novelty resides merely in the particular composition. On the contrary, the classification examiner's sound reason for refusing to approve a division between the claims defining the composition and those defining the process which employs that composition obviously is based upon the conviction that the improved process is "due to the particular composition used." That is to say, the new composition itself operates to provide a new process.

The Examiner's reason for citing the Ex parte Donnell decision is not understood. That decision seems to have no bearing whatever upon the present situation. It involved a petition to the Commissioner "that the Examiner be directed to enter and consider an amendment" in an ap- [fol. 1130] plication relating to a pressure gauge for automobile tires. The petition was granted because the Examiner had not fully explained his rejection of certain claims upon the authority of the case In re McNeil. Evidently it was the Examiner's opinion that the applicants' invention resided in an element (the safety valve per se) and not in the combination. No process claims were involved there,—the decision merely relates to one of proper practice in treating combination claims and subcombination claims covering a mechanical invention.

The present situation clearly is governed by the principles set forth in the following cases, among others:

Ex parte Chamberlain, 1931 C. D. 10;
Ex parte Kurtz, Jr., 15 Pat. Q. 149;
Ex parte Prescott & Morikawa, 19 Pat. Q. 178;
Ex parte Dow, 25 Pat. Q. 263.

All of these decisions clearly support applicants' contention that the use of a new composition, particularly in a chemical or metallurgical process, such as the present one, confers novelty upon the process. For example, in Ex parte Chamberlain the applicant had used a new or different chemical reagent in a pickling bath and presented claims covering a method of cleaning or pickling metals which involved passing the metals through the new pickling bath. The Examiner rejected such claims "solely on the ground that a new process is not produced by the use of each different specific substance in the pickling bath over the pickling of metal by baths containing other non-inhibitors x x x and that the claims should be in terms of composition of the bath only". The Board of Appeals, however, reversed the Examiner saying that the action involved in the [fol. 1131] invention at bar

> "is of a chemical nature rather than physical and x x x the steps employed are classifiable as a chemical process instead of a mechanical method. In such case we find no difficulty in concluding that each chemical agent used constitutes a proper subject for a process claim on the ground that although the mechanical steps of immersing the metal in the various baths is the same, the chemical action is different in each case, due to the different chemical reagents, and this constitutes a different process."

Similarly, although applicants' welding procedure and that of Robinoff et al are superficially similar, the novel welding composition used by applicants constitutes a different chemical reagent and produces a different chemical and metallurgical result, and thus provides a new process which is patentable.

Respectfully submitted, Eugene L. Greenewald, Attorney for Applicants.

New York, N. Y. September 19, 1935.
A. G. M.

[1132] 181 .

Div. 60, FR

Serial No. 705,892

Department of Commerce, United States Patent Office, Washington

Address only The Commissioner of Patents, Washington, D. C.

November 11, 1935.

Lloyd T. Jones, et al, assors

Your application for a patent for an improvement in Electric Welding filed Jan. 9, 1934, has been examined and allowed with 12 claims.

The final fee, Thirty dollars, with $1 additional for each claim allowed in excess of 20, must be paid not later than six months from the date of this present notice of allowance. If the final fee be not paid within that period, the patent will be withheld, but the application may be renewed within one year after the date of the original notice with a renewal fee of $30 and $1 additional for each claim in excess of 20.

The office delivers patents upon the day of their date, on which date their term begins to run. The preparation of the patent for final signing and sealing will require about four weeks, and such work will not be begun until after payment of the necessary final fee.

When the final fee is paid, there should also be sent, distinctly and plainly written, the name of the Inventor, Title of the Invention, and Serial Number as above given, date of allowance (which is the date of this circular), date of filing, and, if assigned, the names of the assignees.

If it is desired to have the patent issue to an assignee or assignees, an assignment containing a request to that effect, together with the fee for recording the same, must be filed in this office on or before the date of payment of the final fee.

After issue of the patent, uncertified copies of the drawings and specifications may be purchased at the price of ten cents each. The money should accompany the order. Postage stamps will not be received.

The final fee will not be received from other than the ap-

plicant, his assignee or attorney, or a party in interest as shown by the records of the Patent Office.

Notice.—When the number of claims allowed is in excess of 20, no sum less than $30 plus $1 additional for each claim in excess of twenty can be accepted as the final fee.

Respectfully, Conway P. Coe, Commissioner of Patents.

Charles C. Scheffler, 30 E. 42nd St., New York, N. Y.

In remitting the final fee give the serial numbers at the head of this notice. Uncertified checks will not be accepted.

[fol. 1133] [Stamp:] Mail Division, Mar. 26, 1936, U. S. Patent Office.

[Stamp:] U. S. Patent Office, Mar. 26, 1936, Division 60.

[Stamp:] U. S. Patent Office Mar. 27, 1936. Issue Division.

In the United States Patent Office

Div. 60, Room 5896

L. T. Jones et al. Electric Welding. Serial No. 705,892. Filed January 9, 1934

Formal Abandonment.

To the Commissioner of Patents, Washington, D. C.

Sir:

The above-identified application, but not the invention disclosed therein, is hereby formally abandoned in favor of application Serial No. 44,142, filed October 9, 1935, by Lloyd T. Jones, Harry E. Kennedy, and Maynard A. Rotermund. The latter application contains claims directed to the invention claimed in the former application.

A formal Authorization to Abandon, signed by the inventors, is filed herewith.

Respectfully, Eugene L. Greenewald, Attorney for applicants,

New York, N. Y., March 25, 1936.
G/K.

[fol. 1134] [Stamp:] U. S. Patent Office, Mar. 26, 1936. Division 60.

[Stamp:] Mail Division, Mar. 26, 1936. U. S. Patent Office.

[Stamp:] U. S. Patent Office, Mar. 27, 1936. Issue Division.

In the United States Patent Office

Div. 60, Room 5896

L. T. Jones et al. Electric Welding. Serial No. 705,892. Filed January 9, 1934

Authorization to Abandon

We, Lloyd Theodore Jones, Harry Edward Kennedy, and Maynard Arthur Rotermund, of Berkeley, California, the joint inventors in the above-entitled application, hereby authorize our attorneys, Charles C. Scheffler and Eugene L. Greenewald, or either of them, formally to abandon the above-identified application but not the invention disclosed therein. This authorization is made in view of the presentation in our copending application Serial No. 44,142, filed October 9, 1935, of claims directed to the invention claimed in the above-identified application.

Lloyd Theodore Jones, Harry Edward Kennedy, Maynard Arthur Rotermund.

Berkeley, California, February 26, 1936.
G/K.

[fol. 1135] [Stamp:] Mail Division, Apr. 4, 1936, U. S. Patent Office.

[Stamp:] U. S. Patent Office, Apr. 6, 1936. Division 60.

[Stamp:] U. S. Patent Office, Apr. 7, 1936. Issue Division.

In the United States Patent Office

Div. 60, Room 5896

Jones, Kennedy & Rotermund. Electric Welding. Serial No. 705,892. Filed Jan. 9, 1934

Hon. Commissioner of Patents, Washington, D. C.

SIR:

In response to Chief Clerk's letter of April 1, 1936 there is filed herewith a formal consent to the abandonment

signed by an officer of the assignee corporation and bearing the corporate seal of said corporation.

Respectfully, Eugene L. Greenewald, Attorney for applicants.

New York, N. Y., April 3, 1936.
B/LK.

[fol. 1136] [Stamp:] Mail Division, Apr. 4, 1936, U. S. Patent Office.

[Stamp:] U. S. Patent Office, Apr. 7, 1936, Issue Division.

In the United States Patent Office

Div. 60, Room 5896

Jones, Kennedy & Rotermund. Electric Welding. Serial No. 705,892. Filed Jan. 9, 1934

Consent to Abandonment

Hon. Commissioner of Patents, Washington, D. C.

SIR:

Union Carbide and Carbon Research Laboratories, Inc. hereby consent to the authorization to abandon the above-entitled application, but not the invention disclosed therein; signed by Messrs. Jones, Kennedy & Rotermund, on or about February 26, 1936 and ratify the action of their attorneys in formally abandoning this application in favor of application Serial No. 44,142, filed October 9, 1935.

Respectfully, Union Carbide and Carbon Research Laboratories, Inc., by Albert C. Cornell, Secretary.

New York, N. Y., April 3, 1936.
B/LK.

[Stamp:] Abandoned 4/4/36.

[fol. 1137] April 1, 1936.

Messrs. Jones, Kennedy and Rotermund, Care Mr. Charles C. Scheffler, 30 East 42nd Street, New York, N. Y.

GENTLEMEN:

I have your letter of Abandonment in connection with your application filed January 9, 1934, for Electric Welding, Serial No. 705,892, allowed November 11, 1935.

You are advised that the letter of abandonment is found to be informal in that it fails to bear the signature of the Assignee.

Before the case may be considered Abandoned, it is necessary that a letter be filed bearing the proper signature. (See Rules of Practice, Rule 171.)

An early reply will be appreciated.

Sincerely yours, J. A. Brearley, Chief Clerk.
L (Div. B).

[fols. 1138-1154] April 8, 1936.

Messrs. Jones, Kennedy and Rotermund, Care Mr. Charles C. Scheffler, 30 East 42nd Street, New York, N. Y.

GENTLEMEN:

I have your letter of Abandonment in connection with your application filed January 9, 1934, for Electric Welding, Serial No. 705,892, allowed November 11, 1935.

The application has been marked Abandoned in accordance with your request.

Sincerely yours, J. A. Brearley, Chief Clerk.

[fol. 1155] PLAINTIFF'S EXHIBIT 127

390.

Department of Commerce, United States Patent Office

To all persons to whom these presents shall come, Greeting:

This is to Certify that the annexed is a true copy from the records of this office of the File Wrapper and Contents, in the matter of the Letters Patent of Lloyd Theodore Jones, Harry Edward Kennedy and Maynard Arthur Rotermund, assignors, by mesne assignments to Union Carbide and Carbon Corporation, Number 2,043,960, Granted June 9, 1936, for Improvement in Electric Welding.

In Testimony Whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington, this fourth day of October, in the year of our Lord one thousand nine hundred and forty-five and of the Independence of the United States of America, the one hundred and seventieth.

Casper W. Ooms, Commissioner of Patents. Seal.

Attest:

F. A. Coulter, Acting Chief of Division.

PATENT OFFICE
RETURN TO RECORD ROOM

NUMBER (Series of 1911) 44142

PATENT NO. 2043960

DIV. 60

DATED 1935

(EX'R'S BOOK) 43-4

LLOYD THEODORE JONES, HARRY EDWARD KENNEDY, AND
MAYNARD ARTHUR ROTERMUND

BERKELEY

State of CALIFORNIA

Invention ELECTRIC WELDING

filed

APPLICATION FILED

	ORIGINAL	RENEWED
APPLICATION FILED COMPLETE	OCT 9 , 1935	
Petition, Specification, Oath, Fir's Fee $30, sh ~~wts Drawings~~,	OCT 9 , 1935	
11 EXTRA CLAIMS $11	OCT 9 1935	

filed

PARTS OF APPLICATION FILED

	ORIGINAL	RENEWED
APPLICATION FILED COMPLETE	OCT 9 , 1935	
Petition, Specification, Oath, Fir's Fee $30, sh ~~wts Drawings~~,	OCT 9 , 1935	
11 EXTRA CLAIMS $11	OCT 9 1935	

Division of App., No.

Examined and passed for Issue May 2, 1936
R. F. Gloss Exr. Div. 60
MAY 6 1936
By Commissioner.

Reexam'd and passed for Issue 193
..... Exr. Div.

Notice of Allowance 193

Final Fee $30 Mar 14, 1936

Notice of Allowance 193

Final Fee 193

Attorney CHARLES C. SCHEFFLER & EUGENE L. GREENEWALD 30 EAST 42ND ST NEW YORK N.Y.

Associate Attorney

No. of Claims Allowed 22 Print Claims 1, 12 in O.G. Class 21 - 12

Title as allowed Electric Welding

11-1156

1156

[fol. 1157] [Stamp:] Mail Division, U. S. Patent Office, Oct. 9, 1935

UNION CARBIDE AND CARBON RESEARCH LABORATORIES, INC.

Carbide and Carbon Building

30 East Forty-Second Street

New York

Patent Department.
Cable Address: Patuncarb New York.

October 9, 1935.

Hon. Commissioner of Patents, Washington, D. C.

SIR:

We are sending you herewith our check No. 193,995 for $41.00, to cover the filing fee in the following patent application, the necessary papers of which are attached:

Lloyd Theodore Jones, Harry Edward Kennedy, and Maynard Arthur Rotermund, "Electric Welding." Executed October 1, 1935. (31 claims.)

Respectfully, Patent Department, C. C. Scheffler, E. D.

Ed. Encl.

[fol. 1158] [Stamp:] Mail Division, U. S. Patent Office. Oct. 9, 1935

Petition for United States Letters Patent

To the Commissioner of Patents of the United States of America:

Your petitioners, Lloyd Theodore Jones, Harry Edward Kennedy, and Maynard Arthur Rotermund, citizens of United States, residing at Berkeley, in the County of Alameda, and State of California. P. O. Addresses 896 Santa Barbara Road; 103 Tunnel Road; 479 Kentucky Avenue, Berkeley, California (respectively) pray that Letters Patent may be granted to them, for Improvements in Electric Welding set forth in the annexed specification; and do hereby appoint Charles C. Scheffler, Register No. 11032, and

Eugene L. Greenewald, Register No. 3276, both of 30 East 42nd Street, New York, New York, their attorneys with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to sign their name to the drawings, to receive the Letters Patent, and to transact all business in the United States Patent Office connected therewith, the power to be exercised either separately or collectively by said attorneys as they shall from time to time elect, Please address all communications to Charles C. Scheffler.

Signed at Albany in the County of Alameda and State of California, the 1st day of October, 1935.

(S.) Lloyd Theodore Jones, Harry Edward Kennedy, Maynard Arthur Rotermund.

Specification

To All Whom It May Concern:

Be It Known That We, Lloyd Theodore Jones, Harry Edward Kennedy, and Maynard Arthur Rotermund, citizens of United States, residing at Berkeley in the County of Alameda and State of California have invented certain new and useful Improvements in Electric Welding of which the following is a specification:

[fol. 1159] This invention relates to electric welding.

Among the various ways in which electrical energy has been converted into heat for the welding of metals, the arc process (which itself takes several forms) is the one most generally practiced. A typical example of arc-welding is its use to join the abutting edges of steel plates. In the metal-arc variation of the arc process, molten metal, provided by the melting of a metal wire or rod of suitable composition, is introduced between the abutting edges of the plates, and the latter are fused sufficiently to permit the added metal to coalesce with the metal of the plates so that, on cooling, a structurally strong bond results. The requisite heat is developed, as the term "arc process" implies, by maintaining either a direct current or an alternating arc between the parts to be welded, connected to one side of the power line, and the wire or rod used to supply the molten metal, connected to the other side of the power line. The abutting plate edges are usually beveled to form a trough for receiving the molten metal, thereby facilitating coales-

cence of the added metal with the plates throughout the thickness of the latter.

The simplicity of bare-wire-electrode welding recommends it above all other methods, but the metallurgical and physical properties of metal deposited in this simple manner are usually so poor that the method is unsuitable for many applications.

In order to avoid certain difficulties encountered in bare metal arc welding, it is customary to protect the freshly deposited molten metal with a blanket of molten metal com- [fol. 1160] pounds (usually compounds of the alkali or alkaline earth metals). The material used for forming this blanket is called the "flux." The usual method of providing a flux blanket on the weld is to encase the welding rod or wire (usually referred to as the electrode) in an adherent sheath of solid flux, and this gives rise to other difficulties. The sheath is usually fragile and, being nonmetallic in nature, is nonconductive when cold, so that electrical connection must be made with the electrode at points bared for that purpose at intervals at variable distances from the weld, thereby imposing an additional burden on the automatic regulating devices widely used in welding. When the bared sections reach the melting zone metal of inferior quality is deposited. The current must pass through a variable length of rod, the length between the arc and the contact point, heating it sufficiently to crack off the flux covering and further to add an IR-drop to the arc voltage. This IR-drop is not constant in magnitude but varies according to the position of the contact point relative to the arc. The machine, unable to discriminate between arc voltage and electrode drop, cannot maintain the constant arc length so necessary to successful welding unless compensatory means are resorted to. These difficulties therefore limit the energy which may be expended in the arc. We are not aware of current values in excess of about 500 amperes being used in this manner of welding.

For good welding a homogeneous deposit of metal is indispensible. In metal-arc welding it is found that the difficulties involved in securing a homogeneous deposit are multiplied as the thickness of the deposit increases, so that, if thick plates are to be welded, it becomes necessary to [fol. 1161] make several traverses or "passes," adding a layer of metal each time until the necessary thickness is

attained. This method of operation is obviously time-consuming, the more so since it is usually necessary to chip off the cover of solidified flux on one deposit, and peen the metal, before another deposit can be superimposed. It also complicates the stresses set up by contraction of the metal in the cooling weld, and the resulting distortion of the welded parts.

There is another known means of applying protective flux. It consists in utilizing a thick coating of finely divided material, a flux, which covers the seam to be welded. The welding electrode, which is a bare wire of suitable composition, is fed down by conventional feeding means and the arc is struck under this powdered flux. The electrode is traversed at a constant rate along the path to be welded. Direct current is applied at a voltage of about 30 volts with a current up to about 900 amperes. The flux used in this system has been a natural clay of approximately the composition used in making brick. The following is a typical analysis of such a flux: 50.6% SiO_2; 18.86% Al_2O_3; 4.34% Fe_2O_3; 5.00% CaO; 6.00% Mn; 3.03% Fe. Although this method retains the advantage of feeding current continuously to a bare wire at a point adjacent to the weld, the weld metal deposited thereby is seriously deficient in quality. A weld made by this method may have ample strength for certain purposes, but it is so porous that it can hardly be said to be satisfactory. It is, therefore, customary to hand-weld on the bottom side to insure superficial freedom from holes. It has not been found possible to extend this method beyond ½ inch plate and there is no immunity from undesirable porosity in any thickness. Moreover, the [fol. 1162] vigor of the arc submerged under this flux projects a continuous cloud of material into the atmosphere. An evidence of the amount of gas that is emitted by a flux of this nature is afforded by the fact that the welders very frequently wear gas masks to protect themselves from the dust. Since the dust is thrown up by gas that is evolved from the flux and the weld metal, it is not surprising that gas-holes should be found in the metal of the weld.

An object of the present invention is to avoid the disadvantageous features cited above, and to provide a process by which even thick plates can be strongly and rapidly electrically welded, in a single pass or in a plurality of passes, with a weld of which the density and physical properties are at least equal to those of the parent metal. Another

object is to provide a process in which heavier welding currents can be used and the rate of welding accelerated. A further object is to overcome the difficulties which, in prior processes, are caused by the inherent instability of an electric arc, its liability to the extinguished by a variety of adventitious causes, and the difficulty, especially in automatic machines, of reestablishing the arc when it has been extinguished. Another object is to avoid the necessity for a flux sheath on the electrode. Other objects of the invention will become apparent as the description of our invention proceeds.

We have discovered a novel process for electric welding wherein the necessary heat is generated by the passage of a heavy electric current between a metal electrode (usually bare) and the metal plates or similar objects to be welded, the electrode being out of mechanical contact with the objects and the current being carried across the gap between the [fol. 1163] electrode and the objects by and through a conductive melt or welding composition having appropriate electrical resistance properties. The heat thus generated melts successive portions of the electrode and the molten material is deposited as weld-filler material. The welding composition serves as an active instrumentality, or welding medium, inasmuch as it provides heating means, controls the rate, penetration, and quality of welding, purifies the molten metal, and protects the molten metal.

A large number of experimental welds which we have made support the conclusion that the properties of a successful welding composition for this method of welding are these:

(1) The chemical reactions between the components of the welding composition must be completed before it is used in welding. Failure in this regard most surely invites porosity.

(2) It must be capable of controllng the penetration and the width of the weld.

(3) Its fluidity at welding temperatures musf be such that it will not become entrained with the molten metal.

(4) It must consist of chemicals which are not detrimental to the properties of the steel, and

(5) It must be readily removable from the finished weld.

The composition of the welding medium is of the utmost importance. The particular composition that is to be used is determined by the quality and thickness of the metal plates to be welded, by the current and voltage to be used, and by the properties it is desired to impart to the weld metal.

[fol. 1164] We have used calcium silicate and silicates of sodium, barium, iron, manganese, cobalt, magnesium, nickel and aluminum, both in binary and ternary combinations, in various proportions. We have also used calcium titanate and various titano-silicates, these being used when it is desired to introduce titanium into the weld metal. While a number of these conductive welding compositions are more or less efficacious in our process, we prefer to use silicates of the alkaline earth metals, such as calcium silicate, and we also prefer to add to these silicates minor proportions of alumina and of a substance adapted to lower the melting points, for example, a halide salt.

More specifically, the welding composition preferably comprises, as its principal ingredients, silica (SiO_2), at least one basic constituent consisting of an alkaline earth such as lime (CaO) or magnesia (MgO) or a mixture thereof, and alumina (Al_2O_3). The silica and basic constituent are in approximately the proportions theoretically required to form metasilicates, although a substantial excess of silica is permissible and frequently advisable. For example, if the basic constituent is lime, the proportions by weight will be approximately 0.7 to 1 part of CaO to 1 part of SiO_2; and if magnesia is substituted for part or all of the lime, the silica is increased accordingly, so as to maintain about the same stoichiometric proportions. The alumina forms about 1% to 8%, by weight, of the welding composition, and preferably about 4% to 6%. In order to cause the energy to be distributed over a larger area we add, in various minor proportions, say 6%, a material capable of reducing the energy concentration and thereby widening the weld. A preferred material for this purpose is a halide salt such as calcium fluoride.

[fol. 1165] The basic constituent preferably consists chiefly of lime and magnesia in approximately the proportions of three parts of CaO to one part of MgO, by weight; but other proportions are useful and within the invention. Basic materials other than lime or magnesia, for example oxides of manganese, titanium, or the alkali metals, and known

fluxing agents such as borax or boric acid, may be added in moderate amounts without greatly changing the essential characteristics of the welding composition, but it is important that the composition be substantially free from iron oxides uncombined with other ingredients of the composition (by being prefused with such ingredients, for instance), and from materials (such as carbonates or moisture) which evolve detrimental amounts of gas or vapor at welding temperatures.

It is possible, and may at times be desirable, to include in the welding composition materials which are transferred to the weld filler material during the welding operation and appear in and modify the properties of the completed weld, for example: ferromanganese, ferrosilicon, ferrochromium, calcium molybdate, carbon, or reducible chemical compounds thereof.

In a specific instance, we fused together 50 pounds of calcium carbonate, 9.4 pounds of magnesium oxide, and 40.5 pounds of silica until the reaction was complete. The materials used were of the purest quality used in the ceramic industries, but the fused product showed the presence, on analysis, of about 5% alumina. The fused material was cooled and granulated, and to each pound, one ounce of fluorspar was added. The material was then ready for use to form the conductive melt which is the principal feature of our process.

[fol. 1166] Welding compositions which have been used successfully and which serve as representative examples within the invention have the following analyses, by weight:

	I	II	III	IV
% CaO	29.5	31.24	29.18	40.12
% MgO	8.7	11.01	8.26	0.89
% SiO_2	56.4	52.40	57.48	52.94
% Al_2O_3	5.4	4.11	4.86	5.80
% Fe_2O_3	Low	0.13	0.24	0.23

Before use, about 1 part of calcium fluoride was added to 16 parts, by weight, of each of the above compositions.

The chemical condition of the welding composition or medium is important: the acidic and basic constituents should be reacted, the composition should be substantially

anhydrous and free from gases, and all reactions which would evolve deleterious amounts of gases during welding should be substantially completed, before the medium is used in the welding process. These conditions are suitably attained by prefusing a mixture of the constituents, preferably in an electric furnace. Certain relatively volatile but chemically stable constituents such as calcium fluoride may be added to the medium either before or after the other ingredients have been fused and cooled. The carbonates of calcium or magnesium may be substituted for the oxides, of course, if the ingredients are prefused.

[fol. 1167] The physical condition of the welding composition is likewise of the utmost importance. If the molten medium is rapidly solidified by cooling, before grinding and use, more homogeneous and solid welds may be produced than when it slowly loses heat and solidifies. The fused composition is preferably cast as a relatively thin layer against efficient cooling or chilling means such as a cold heavy plate or block of metal, or a water-cooled chill plate, rather than as a large ingot. It is preferred that the rate of cooling be such that substantially all of the solidified welding composition is characterized by a vitreous fracture.

In practicing our process the plates to be welded are arranged as for metal open arc welding. The edges are preferably beveled, but this is less necessary than with arc welding because the "penetration" and width of the weld (the extent to which the edges of the plates are fused during the welding) is dictated by the composition of the flux and the voltage and current employed, and can be closely controlled in our process. Means for "backing-up" the seam during welding is preferably used.

When a weld is to be made between beveled edges the space,

Per C. operation is started by filling the groove, ^ or gap between the edges of the objects with the welding composition, preferably in powdered or granular form, and a substantial additional quantity of the composition is heaped up along thereby overfilling the said groove.

" C. the groove, ^ After the weld is completed, that portion of the composition which has not been fused may be removed, by a vacuum system for example, collected and reused. The portion which has been fused may be lifted from the weld, exposing a clean and uniform

[fol. 1168] weld surface. The fused material may be reground and reused, any volatile constituents, such as halides, being replaced. However, under some circumstances the reuse of the welding composition results in a somewhat inferior weld, probably because the composition has picked up impurities during its use.

According to the welding method of the invention, the end of the welding electrode, which is preferably a bare metal electrode, is first inserted into the welding composition. Since the composition is nonconductive when cold, a conductive path for the welding current is provided by bridging the gap between the electrode and the work with, for example, a sliver of graphite or a wad of steel wool. The power is then applied, the welding composition is locally heated until it fuses and becomes conductive, forming a subsurface pool, and immediately thereafter the end of the electrode begins to fuse and the molten metal begins to deposit displacing the subsurface pool of fused welding composition.

Per C.

" C. in the groove, At the same time the edges of the objects being welded begin to fuse and to coalesce with the deposited metal. The electrode is then fed toward the work and moved along the seam at an appropriate rate, preferably by a mechanical device which may be similar to those which are extensively used in open arc welding, and the welding proceeds without interruption.

Per C. The welding proceeds under a protective layer of the composition unobtrusively. There is practically no puffing or visible displacement of the welding medium, no visible sparking, and, indeed, scarcely any external evidence that a weld is being made. The weld is ordinarily completed in one pass, even in thick plate. The welding composition in front of the electrode remains unfused, while the fused [fol. 1169] composition rises to the top of the completed portion of the weld and solidifies. Even this effect is scarcely visible because of the use of an excess of the welding composition which remains unfused and covers the fused composition and metal.

It is possible in our process to use either alternating or direct current, or direct current superimposed on alternating current. Alternating current alone is preferred.

The results attained are influenced, as in open arc welding, by the potential or voltage difference between the electrode and the work, by the magnitude of the welding current, by the size of the electrode, and by the rates at which the electrode is fed toward the seam and traversed along the seam. Assuming a constant welding speed, the welding voltage and current vary with the plate thickness, each being a function thereof. For example, we may use a welding voltage of about 36 volts and a welding current of about 1500 amperes when welding together steel plates about one inch thick using a bare welding rod about 3/8 inch in diameter and a welding speed along the seam of about 8 inches per minute. The welding current may rise to 2000 amperes or more, and with such heavy currents plates 1.5 to 2 inches thick may be welded in one pass at a rate of 6 or 7 inches per minute.

The preferred welding current is a function of several factors including the diameter of the electrode, the rates of penetration, deposition of metal, and travel along the seam, the penetration of the work piece, and the composition of the flux. It is a characteristic of the invention that, for an electrode of a given size, the preferred current is far greater than can be used successfully in processes heretofore known. The following table indicates the order of [fol. 1170] magnitude of the current in the old and new processes, for the purposes of comparison, but it will be realized that the invention is not limited to the use of the current values shown.

Electrode Diameter inches	Current Amperes The Invention	Old Methods
3/16	500 to 800	170 to 210
1/4	800 to 1200	225 to 300
5/16	1250 to 1700	300 to 400
3/8	1500 to 2200	375 to 525

In welding very heavy plate it is sometimes advantageous to use two passes rather than only one, because of mechanical difficulties in supplying large amounts of filler metal rapidly. The facts that the weld has little or no internal stress, and that the flux lifts off easily, leaving a clean surface, expedite the two-pass method.

Welds made by our process have certain distinguishing

characteristics. A cross section of our weld shows, in most cases, that the planes defining the ultimate zone of fusion at the sides of the weld are approximately parallel. This relation is almost independent of the character of the V and obtains whether the parts are preliminarily beveled to a wide V, to a narrow V, or are not beveled at all. The deposit of metal occurs, not directly under the electrode, but back of it, and there appear to be liquid currents (possibly caused by the so-called "pinch effect") which cause the surface of the resistive composition to be depressed at the point where it is first fused, that is, just behind the electrode, and cause both the deposited metal and the conductive [fol. 1171] melt to be heaped up back of the electrode. This facilitates the production of a weld having the desirable upwardly convex surface, with some excess metal above the seam, which can either be machined off, or, as in the usual practice, left for reinforcement. The relatively high current densities which are preferably used superheat the molten metal and welding composition, making them highly fluid. The liquid currents set up in this highly fluid mass effectively mix the metal and welding composition, thereby cleansing or

Per C. washing impurities out of the metal, and then completely separate the metal as it is deposited. As a result, unusually clean and strong metal is deposited. Since the amount of metal solidifying is uniformly wide, unequal stresses, which would tend to warp the plate, are not created, and the weld is of such low internal stress that no evidence of plate deflection is apparent after its completion.

Several circumstances show clearly that our process does not depend on the formation of an arc of the usual type. If, while a weld is being made, the circuit is opened externally of the weld and then closed again while the resistive composition is still molten, the current will immediately resume its flow without any necessity for moving the electrode into contact with the seam as it would be necessary to do to reestablish an arc of the usual type. The heat for melting the electrode is evidently developed in the conductive melt itself.

The conductive welding composition used in our process doubtless performs the protective functions of a flux, but it is much more than a flux, and many compositions which are satisfactory fluxes for arc welding are unsuitable for

our purpose. When an electric current is passed through a [fol. 1172] material which becomes a Nernst conductor at a low temperature a relatively large area of the material will be engaged in the conduction. Common salt (Na Cl) is a material of this class: if it is used, the current is conducted from the electrode to the plate almost entirely by the fused electrolyte. So much salt is involved in the conduction that the energy density is insufficient to produce fusion of the plate or wire. If, on the other hand, a material becomes a Nernst conductor at an exceedingly high temperature, very little of the material is involved in the conduction, the energy is thereby so concentrated as to melt very deeply and with very small cross section. By a proper selection of welding composition, as explained hereinabove, the energy density on the parts to be welded may be satisfactorily controlled and the production of a sound weld may be assured.

This application is a continuation, in part, of our prior applications Serial Numbers 657,836 and 705,892, respectively, filed February 21, 1933 and January 9, 1934.

[fol. 1173] We claim:

Sub B[3]

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1. A method of electric welding which consists in subjecting the parts to be joined to the action of an electric current, said current passing substantially wholly through a flux placed on the parts to be joined, said flux consisting of two components, one acid and one basic, chemical reaction between the components having been previously completed.

2. A method of electric welding in the presence of a flux which consists in substantially enclosing the gap between the electrode and the work in a flux which has been rendered chemically inactive.

Insert D[1].

3. The method of electric welding by melting a metal electrode, depositing the metal so melted upon a metal work piece, and coalescing said melted metal with adjacent fused metal of said work piece, which method comprises supplying

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[Matter enclosed between rules erased in copy.]

heat for said welding by passing an electric current from said electrode to said work piece through a
Insert B¹ fused nonmetallic material ∧, and maintaining
B¹
said material in constant contact with said
to avoid
per B. electrode and work piece ∧ [whereby]* the

air
" B. formation of a substantial ∧ [gas]*-conducted

between the electrode and work piece
" B. electric arc ∧ [is avoided]*.

4. The method of electric welding by melting a metal electrode, depositing the metal so melted upon a metal work piece, and coalescing said melted metal with adjacent fused metal of said work piece, which method comprises supplying heat for said welding by passing an electric current from said electrode to said work piece through a pool of nonmetallic material fused *in situ* without material evolution of gas, and maintaining said pool in constant electrical contact with said electrode and work
to avoid
" B. piece ∧ [whereby]* the formation of a substan-

air
Insert B². tial ∧ [gas]*-conducted electric arc ∧ [is

B²
avoided]*.

[fol. 1174] 5. The process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive path of a high-resistance melt of fusible silicate, substantially free from substances, such as uncombined iron oxide, capable of evolving large amounts of gases when

[* Words and figures enclosed in blackets erased in copy.]

fused in contact with the metal to be deposited; passing through said melt an electric current of sufficient magnitude to maintain the conductivity, progressively melt the said electrode and cause the resulting molten metal to coalesce with said member; and maintaining said melt in contact with said electrode and member throughout the welding operation.

6. The process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive melt comprising an alkaline earth metal silicate, alumina, and an alkaline earth metal fluoride, substantially free from substances, such as uncombined iron oxide, capable of evolving gases when fused in contact with the metal to be welded; passing through said melt an electric current of sufficient magnitude to maintain the conductivity, progressively melt the said electrode and cause the resulting molten metal to coalesce with said member; and maintaining said melt in contact with said electrode and member throughout the welding operation.

[fol. 1175] 7. The process of electric welding which comprises juxtaposing a metal electrode and a metal member on which metal is to be deposited from said electrode; filling the gap between said electrode and said member with a finely-divided, unbonded, nonmetallic material which is fusible at welding temperatures; heaping an additional amount of said material above said gap so as to submerge said electrode for a substantial distance; fusing a portion of said material in said gap to render the material electrically conductive; progressively moving said electrode along said member; passing through the circuit comprising said electrode, fused material, and work piece an electric current sufficient to melt successive portions of said electrode and said metal member and to maintain a pool of said nonmetallic material in contact with said electrode and adjacent to and covering the molten metal; and simultaneously maintaining said fused pool, said end of said electrode, and said molten metal submerged under a quiet layer of said nonmetallic material.

8. The method of uniting metal work pieces by fusion depositing

Per C. ^ [deposit of]* added metal from an electrode and coalescing such added metal with adjacent fused metal of the work which comprises juxtaposing the work pieces to be united so that a space is provided therebetween at the line of intended union, overfilling said space with unbonded particles of a prefused solidified and ground material capable of refusion *in situ* and active when fused to cleanse the fused depositing metal of an electrode, such refusion and cleaning occurring without substantial apparent gas evolution, and traversing said space with the end of an electrode of the metal to be deposited, said end being sub [fol. 1176] merged in said material, while passing current between the work and the electrode of a magnitude to maintain a localized subsurface pool of said material fused and to fuse the electrode at a rate to effect deposit of sufficient metal therefrom to displace said pool and substantially fill said space as traversed, and maintaining a substantially quiet surface layer of said unbonded particles over the area of fusion.

9. The method of uniting metal work pieces by fusion depositing

Per C. ^ [deposit of]* added metal from an electrode and coalescing such added metal with adjacent fused metal of the work, which comprises juxtaposing the work pieces to be united so that a space is provided therebetween at the line of intended union, traversing said space with an electrode of the metal to be deposited while passing an electric current between the work and the electrode of a magnitude to fuse the latter at a rate to effect deposit of sufficient metal therefrom to substantially fill said space as traversed, bridging the fusing and of said electrode and the adjacent fused local area of the work with a pool of material fused *in situ* without substantial gas evolution, said fused material being electrically conductive and active to cleanse the fused metal of the electrode and the work, and simultaneously maintaining said fused pool, said end of said electrode and said local area of the work submerged under a quiet protective layer of unbonded particles.

[*Words and figures enclosed in brackets erased in copy.]

[fol. 1177] 10. A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive object on which metal is to be deposited, placing between said object and said electrode a high resistance conductive path consisting of a prefused welding composition, and passing through said electrode, welding composition, and object an electric current of sufficient magnitude to establish and to maintain the conductivity of said composition, to melt successive portions of said electrode, and to cause the resulting molten metal to coalesce with said object; said welding composition being substantially free from uncombined iron oxide and from materials which evolve gas at welding temperatures and having for its ingredients

Per C. principal ∧ [constituents]* silica, lime, magnesia, and alumina, and also containing a minor proportion of a halide salt, the silica, lime and magnesia being in approximately the proportions of 27 to 38 parts lime, 9 to 16 parts magnesia, and 60 parts silica, and the alumina composition

Per B. being about 4% to 6% of the ∧ [medium]*.

Insert A¹.>

B

[Sub A¹]*

11. A method of electric welding with alternating current which consists in substantially enclosing the gap between the electrode and the work in a flux having sufficient conductivity to reestablish the welding current between alternations of the voltage.

12. A finely-divided unbonded fusible electric welding composition containing a major proportion of a compound having both a basic component and an acid component, said composition being substantially free from substances capable of evolving substantial amounts of gas under welding conditions.

[Matter enclosed between rules erased in copy.]

[*Words and figures enclosed in brackets erased in copy.]

[fol. 1178] Sub A²

13. A finely-divided unbonded fusible composition for use in electric welding employing a bare metal electrode as a source of weld metal; said composition containing a major proportion of metallic silicate and being substantially free from substances capable of producing substantial amounts of gas under welding conditions.

Sub A⁵

14. A finely-divided unbonded fusible electric welding composition containing a metallic silicate and a material adapted to change the composition of the weld metal deposited during welding, and being substantially free from substances capable of producing substantial amounts of gas under welding conditions.

Sub A³

15. A finely-divided unbonded fusible composition for use in electric welding employing a bare metal electrode as a source of weld metal, said composition containing a halogen compound and a major proportion of alkaline earth metal silicate.

Per B

Cancelled Per D

16. A fluxing material for electric [arc]* welding comprising metallic silicate and calcium fluoride.

17. A finely-divided unbonded fusible electric welding composition containing a fluoride and a major proportion of an alkaline earth metal silicate.

[Matter enclosed between rules erased in copy.]

[fol. 1179] Cancelled Per D

18. A finely-divided unbonded fusible composition for use in electric welding employing a bare metal electrode as a source of weld metal, said composition being substantially free from substances capable of evolving a detrimental quantity of gas under welding conditions and containing calcium fluoride and a major proportion of one or more alkaline earth metal silicates.

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18 [19]*. A composition for electric welding containing a major proportion of alkaline earth metal silicate, and being substantially free from uncombined iron oxide and from substances capable of evolving gases under welding conditions.

19 [20].* A composition for electric welding containing a major proportion of calcium silicate, and being substantially free from uncombined iron oxide and from substances capable of evolving gases under welding conditions.

20 [21]*. A composition for electric welding containing a fluoride and a major proportion of alkaline earth metal silicate, and being substantially free from uncombined iron oxide and from substances capable of evolving gases under welding conditions.

21 [22]*. A composition for electric welding containing a fluoride and a major proportion of calcium silicate and being substantially free from uncombined iron oxide and from substances capable of evolving gases under welding conditions.

Insert D².>

25 [23]*. A composition for electric welding comprising fluorspar, magnesium silicate, and calcium silicate, the latter silicate being present in predominant proportion.

[fol. 1180] 26 [24]*. An electric welding composition which is conductive when molten, consists chiefly of silicates, and contains about 1% to 8% alumina.

[Matter enclosed between rules erased in copy.]

[*Words and figures enclosed in brackets erased in copy.]

27 [25]*. A prefused electric welding composition which is conductive when molten and the principal constituents of which are alkaline earth metal silicates, said composition containing about 1% to 8% alumina and being substantially free from materials such as uncombined iron oxide which evolve large volumes of gas or vapor at welding temperatures.

28 [26]*. A prefused electric welding composition which is conductive when molten, is substantially free from uncombined iron oxide and from materials which evolve large amounts of gas at welding temperatures, and the principal ingredients

Per C. ∧ [constituents]* of which are silica, alumina, ingredient

" C. and at least one basic ∧ [constituent]* of the group consisting of lime and magnesia, the basic ingredients

" C. ∧ [constituents]* being present in an amount between about 70% and about 100% of that theoretically required to combine with all of the silica present to form metasilicate, and the alumina being about 2% to 8% of the composition; and said composition having ingredient

Per C. as a minor ∧ [constituent]* an alkaline earth metal flouride.

29 [27]*. A prefused and comminuted electric welding composition which has a vitreous fracture, is conductive when molten, and consists substantially of silica, lime, magnesia, alumina, and calcium fluoride, the silica, lime, and magnesia being in approximately the proportions of 27 to 38 parts lime, 9 to 16 parts magnesia, and 60 parts silica, the alumina being about 4% to 6% and the calcium fluoride being about 6% of the composition; said composition being uncombined iron oxide

Per B. substantially free from ∧ [iron]* and from materials which evolve gas or vapor at welding temperatures.

[*Words and figures enclosed in brackets erased in copy.]

[fol. 1181] Cancelled Per B

Per A. 28. A method of forming a fluxing material for electric [arc]* welding which consists in mixing two components, one acid and one basic, causing a substantially complete chemical reaction between the components by subjecting them to a sufficient temperature to cause fusion, rapidly cooling the fused material, and then grinding the cooled material.

29. Process of making an electric welding composition which comprises melting together the constituents, whereby all chemical reactions between the constituents are substantially completed and substantially all gases and vapors are driven off, and then rapidly cooling and solidifying the melt whereby a vitreous fracture is imparted to the major portion of the composition.

30. Process of making an electric welding composition which comprises melting together silica, at least one basic constituent of the group consisting of lime and magnesia, and alumina, the basic constituents being present in an amount between about 70% and about 100% of that theoretically required to combine with all of the silica to form metasilicates, and the alumina forming about 2% to 8% of the composition, and then casting the melt in a relatively thin layer against cold metal, whereby a vitreous fracture is imparted to the major portion of the welding composition.

[fol. 1182] Cancelled Per D.

31. The method of electric welding by melting a metal electrode, depositing the metal so melted upon a metal work piece, and coalescing said melted metal with adjacent fused metal of said work piece, which method comprises supplying heat for said welding by passing an electric current, at a density of upwards of about 2000 amperes per inch of

[Matter enclosed between rules erased in copy.]

[* Words and figures enclosed in brackets erased in copy.]

diameter of said electrode, substantially wholly through silicate

Per B. a pool of ^ [non-metallic material]* fused

" B. *in situ*, without the formation of any substantial gas-conducted electric arc.

[fol. 1183] In Testimony whereof, we affix our signatures.
Lloyd Theodore Jones, Harry Edward Kennedy, Maynard Arthur Rotermund.

Oath

County of Alameda,
State of California, ss:

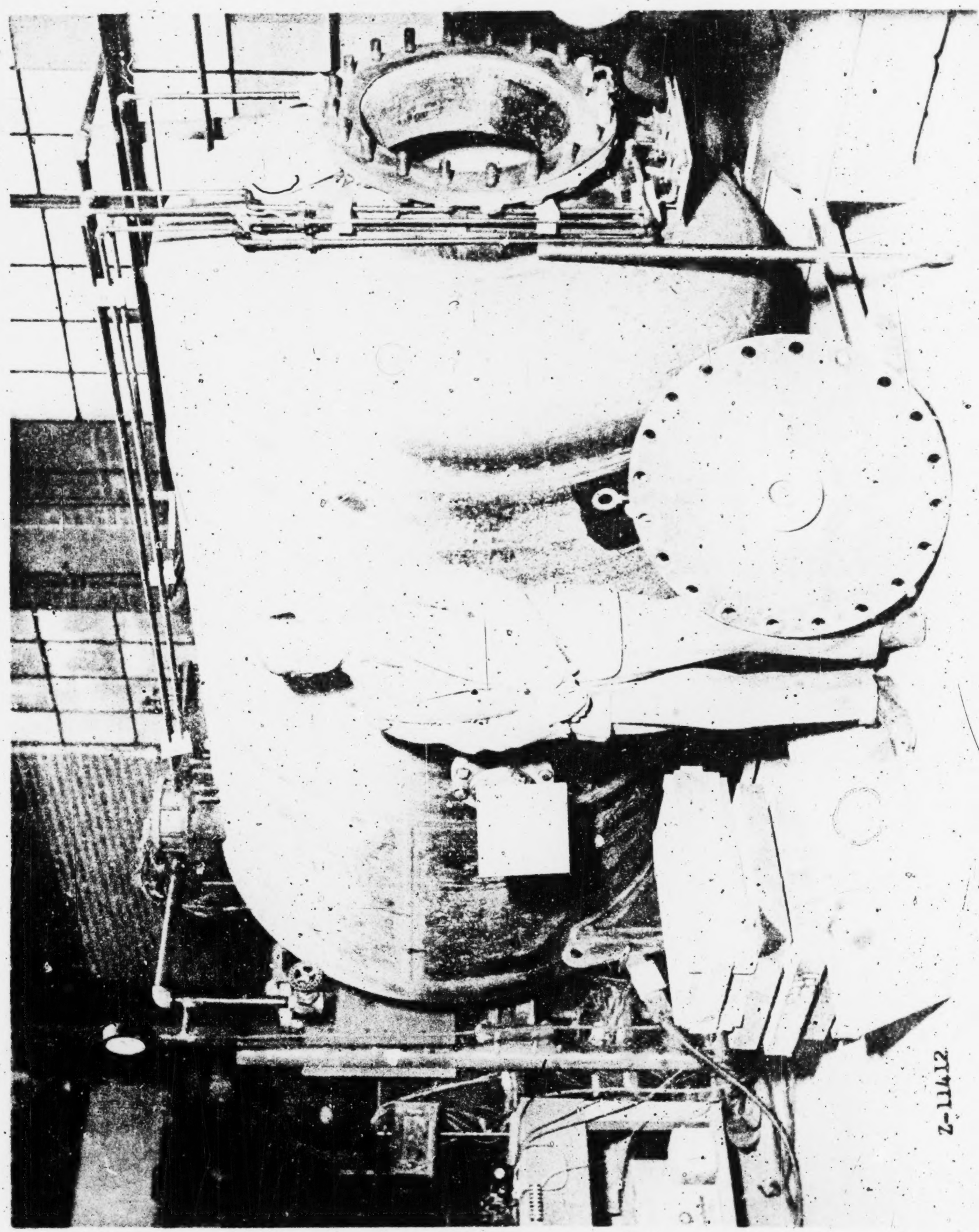
Lloyd Theodore Jones, Harry Edward Kennedy, and Maynard Arthur Rotermund the above named petitioners, being duly sworn, depose and say that they are citizens of United States and residents of Berkeley, Alameda County, California, that they verily believe themselves to be the original, first and joint inventors of the Improvements in Electric Welding described and claimed in the annexed specification; that they do not know and do not believe that the same was ever known or used before their invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by them or their legal representatives or assigns more than twelve months prior to this application; and that no application for patent on said improvements has been filed by them or their legal representatives or assigns in any country foreign to the United States.

Lloyd Theodore Jones, Harry Edward Kennedy, Maynard Arthur Rotermund.

Sworn to and subscribed before me this 1 day of October, 1935. C. N. Lavers, Notary Public. My Commission expires Nov. 17, 1936. (Seal.)

[Matter enclosed between rules erased in copy.]
[*Words and figures enclosed in brackets erased in copy.]

PLAINTIFF'S EXHIBIT 175-B



Z-11432

[fol. 1184] [Stamp:] Mailed Oct. 19, 1935.

260

Div. 60, Room 5896

Paper No. 2

Department of Commerce, United States Patent Office, Washington

RLS-FR

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

All communications respecting this application should give the serial number, date of filing, and name of the applicant.

October 19, 1935.

Please find below a communication from the Examiner in charge of this application.

Conway P. Coe, Commissioner of Patents.

Applicant: L. T. Jones et al. Ser. No. 44,142. Filed Oct. 9, 1935. For Electric Welding.

Charles C. Scheffler, 30 E. 42nd St., New York, N. Y.

This case has been examined.
References made of record:—

Severance, 429,777, June 10, 1890, 148-26.
Hammers, 1,752,793, Apr. 1, 1930, 148-26.
Robinoff, 1,782,316, Nov. 18, 1930, 219-10-(67).
Stresau, 1,986,167, Jan. 1, 1935, 219-10-(67).

The claims herein are drawn to three separate and distinct inventions. Thus:

I claims 1 to 11 and 31 which recite a process of welding,
II claims 12 to 27 which recite a flux, and
III claims 28, 29 and 30 which recite a method of making a flux.

Division is required in accordance with Rule 42. The applicant's process may be carried out through a technique other than that involving the flux material delineated by the

claims of group 2, irrespective of the process (of group 3) utilized for making the flux. Further, the flux of group 2 is of utility in welding processes other than arc welding contemplated by the applicant and sugh flux may be produced by other and materially different processes than that delineated by the claims of group 3. Finally, the process of group 3 is not in the least confined to the production of the applicant's specific flux.

The art cited also indicates recognition of distinctness of invention by separate classification. The necessary searches are not coextensive.

Action on the merits awaits settlement of the question of division. No claim is allowed.

R. L. S.

R. L. Glass, Examiner.

[fol. 1185] [Stamp:] Mail Division, Nov. 23, 1935, U. S. Patent Office.

In the United States Patent Office

Div. 60, Room 5896

L. T. Jones, H. E. Kennedy and M. A. Rotermund. Electric Welding. Serial No. 44,142. Filed October 9, 1935

Hon. Commissioner of Patents, Washington, D. C.

SIR:

In response to the Official Letter of October 19, 1935, it is respectfully requested that the above-identified application be amended as follows:

Claim 28, line 2, cancel "arc".

Add the following claims:

A[1]. 11 [32].* A process of electric welding, which comprises the step of forming a conductive high-resistance melt, containing a major proportion of alkaline earth metal silicate and substantially free from uncombined iron oxide, on a metal part to be fused; and passing an electric current through a circuit comprising said melt and said metal part.

[* Words and figures enclosed in brackets erased in copy.]

Add A⁴. Cl. 12.>

A². 13 [33].* A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive path and in contact with

Per B. of high-resistance melt containing a major proportion of alkaline earth metal silicate and substantially free from uncombined iron oxide; and passing along said conductive path an electric current of sufficient magnitude to maintain the conductivity, progressively melt the said electrode and cause the resulting molten metal to coalesce with said member.

Add A⁵. Cls. 14-15.>

[fol. 1186]

A³. 16 [34].* A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive melt and in contact with

Per B. of fusible silicate substantially free from uncombined iron oxide; and passing through said melt an electric current of sufficient magnitude to maintain the conductivity, progressively melt the said electrode and cause the resulting molten metal to coalesce with said member.

A³. 17 [35].* A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive melt and in contact with

Per B. of an alkaline earth metal silicate substantially free from uncombined iron oxide; and passing through said melt an electric current of sufficient magnitude to maintain the conductivity, progressively melt the

[* Words and figures enclosed in brackets erased in copy.].

said electrode and cause the resulting molten metal to coalesce with said member.

Cl. 18 fols.>

A⁴. 12 [36].* A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive melt of fusible silicate, substantially free from substances capable of evolving gases when fused in contact with the metal to be deposited; and passing through said melt an electric current of sufficient magnitude to maintain the conductivity, progressively melt the said electrode and cause the resulting molten metal to coalesce with said member.

Per B. and in contact with

Add A². Cl. 13.>

[fol. 1187] 14 [37].* A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive melt comprising an alkaline earth metal silicate and an alkaline earth metal fluoride; and passing through said melt an electric current of sufficient magnitude to maintain the conductivity, progressively melt the said electrode and cause the resulting molten metal to coalesce with said member.

Per B. and in contact with

15. [38].* A process of electric welding which comprises the steps of juxtaposing a metal electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive melt containing a major proportion of alkaline earth metal silicate and substantially free from uncombined iron oxide; passing electric current through said melt to maintain the conductivity and progressively melt said electrode; and moving said electrode along said mem-

Per B. and in contact with

[* Words and figures enclosed in brackets erased in copy.]

ber while maintaining the current and the conductive melt therebetween.

Add A[3]—Claims 16-17.

Remarks

The claims added above are allowed claims 1 to 7 of parent application Serial No. 705,892. It is applicants' present thought that said parent application (but not the invention) may be formally abandoned in favor of the present application.

It is also respectfully pointed out that claims 16, 17, and 18 are allowed claims 12, 32, and 33 of "grandparent" application 657,836[8]; and claims 19 through 23 are allowed claims 11 through 15 of parent application 705,892.
[fol. 1188] Thus, the following claims have already been allowed in former applications: 16 through 23, and 32 through 38.

For the Examiner's convenience, it is also respectfully pointed out that claims 1, 2, 11 to 15, and 28, are quite similar to the following claims, respectively, of "grandparent" application 657,838: 6, 16, 9, 24, 28, 29, 30, 31, and 5. Also, claims 5 and 6 are similar to, but more limited than allowed claims 5 and 6 of parent application 705,892. The latter two claims appear to be immediately allowable.

It is respectfully requested that the requirement of division be reconsidered and withdrawn, for the reasons explained below. If, however, the requirement is adhered to, and is affirmed by the Examiner of Classification, applicants will elect to prosecute in this application Group I directed to a process of welding, claims 1 to 11, 31, and newly added claims 32 through 38.

The reason that reconsideration of the requirement of division is asked is that applicants believe that this case presents a basically novel inventive concept which runs throughout the claims, unifies them, and renders them so interdependent that division is improper and might well lead to double patenting.

The basically novel concept is in fusion welding by deposition from an electrode, using an electric current as the source of heat, *without the use of a gas-conducted arc.* Hitherto it has never occurred to anyone that such a thing would be even possible of attainment, as is witnessed by the

immense amount of effort put into the development of arc welding.

[fol. 1189] Applicants have found that their concept may be practically attained through the use of a conductive, high-resistance melt of nonmetallic material which melts quietly in the welding area, supplies the welding heat, and evolves no substantial amounts of gas during welding. Claims to the process thus broadly expressed appear to be indivisible from claims to more specific and preferred embodiments of the invention, the process as practiced with melts of certain specific composition and physical state. The latter process claims, on the other hand, appear to be indivisible from claims to the novel melt composition which was developed primarily for use in the new welding process.

This last viewpoint seems to be concurred in by the Examiner, through the allowance of both process and product claims in the parent application Serial No. 705,892. The Examiner's attention is respectfully invited to the Official letter of March 23, 1935 in the record of parent application Serial No. 705,892 wherein the Examiner of Classification *refused to approve* the requirement for division between the process claims and the composition claims, saying:

> "The composition per se is not divisible from the method in which it is used."

Obviously, consistency requires that the quoted decision be applied here too, because the facts respecting these two groups of claims are identical.

Going one logical step further, claims to the preferred melt composition are not divisible from claims to the chill-cast melt of the same composition, a more specific embodiment; and the latter claims are indivisible from the claims to the method of making the chill-cast melt.

Therefore, it will be evident that the subject matters of the several groups of claims are so interdependent that they may be retained in a single application, under Rule 41. [fol. 1190] Finally, the cited art is not believed to be pertinent to the question of division in this case, since it does not indicate that division has been required between a welding process and a flux used therein. The mere fact that the Office classification system happens to divide fluxes and welding processes for greater convenience in searching does not control, because the Office classification is often based on

the necessary and practical basis of splitting down large numbers of patents into smaller groups more convenient to handle, rather than of complete independence of the subject-matter. It is a common occurrence that several classes have to be searched for one invention. The true test of division is: will division require the applicant to take out a plurality of patents on a unitary inventive concept? It is respectfully urged that such would be the case here.

It is noted that the Examiner uses the term "arc-welding" in connection with applicants' process. It is pointed out that the present invention does not involve a gas-conducted arc, thereby distinguishing radically from all prior fusion-deposition electric welding processes. It has never been suspected that fusion-deposition welding could possibly be accomplished electrically without the use of an open, gas-conducted arc.

The references of record have not been applied to the claims and are not believed to be relevant to any claim. Hammers, Robinoff, and Stresau all relate to open-arc welding, and Severance to forge welding. All four patents relate to flux compositions which evolve large amounts of gas during welding ($FeCO_3$, Fe_3O_4, wood flour, etc.), thereby [fol. 1191] inevitably producing an open arc. No reference discloses the method of making the electric welding composition defined in applicants' claims 28 to 30.

Withdrawal of the requirement of division and favorable action on the merits of all claims are solicited.

Respectfully submitted, Eugene L. Greenewald, Attorney for applicants.

New York, N. Y., November 22, 1935.
G/K.

[fol. 1192] January 8, 1936.

Jones, et al. No. 44,142

Examiner, Division 60:

Division was required between I, claims 1-11, 31-38; II, claims 12-27; III, claims 28-30.

Many of the claims of group I appear to distinguish the welding method by the use of the particular flux set forth in group II, compare for example claims 1 and 2 with claim 12, claims 5, 34 and 36 with claims 13 and 14.

The flux of group II however, could be made by processes other than the process of group III as pointed out by the examiner. Group III is for an invention distinct from that of all other claims.

Division between A, claims 28-30 and B, the other claims is approved.

M. F. Bailey, Assist. Chief, Classification Div.

MFB/FBD.

[fol. 1193] [Stamp:] Mailed Jan 15, 1936

260

Div. 60, Room 5896

Paper No. 4

Department of Commerce, United States Patent Office, Washington

RLS-FR

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

All communications respecting this application should give the serial number, date of filing, and name of the applicant.

January 15, 1936.

Please find below a communication from the Examiner in charge of this application.

Conway P. Coe, Commissioner of Patents.

Applicant: L. T. Jones et al, Ser. No. 44,142. Filed Oct. 9, 1935. For Electric Welding.

Charles C. Scheffler, 30 E. 42nd St., New York, N. Y.

Responsive to amendment filed November 23, 1935.

References added to the record:—

Severance	429,777	June 10, 1890	148-26
Lincoln	1,589,017	June 15, 1926	219-8.67
Robinoff et al	1,782,316	Nov. 18, 1930	219-10.67

The question of division has been submitted to the Examiner of Classification, whose decision follows:

Division was required between I, claims 1-11, 31-38; II, claims 12-27; III, claims 28-30.

Many of the claims of group I appear to distinguish the welding method by the use of the particular flux set forth in group II, compare for example claims 1 and 2 with claim 12, claims 5, 34 and 36 with claims 13 and 14.

The flux of group II however, could be made by processes other than the process of group III as pointed out by the Examiner. Group III is for an invention distinct from that of all other claims.

Division between A, claims 28-30, and B, the other claims is approved.

In accordance with the above decision and the applicant's election to prosecute the claims directed to the process of welding, with which the claims drawn to a flux have been grouped, non-elected claims 28, 29 and 30 are not acted upon in this action.

Claims 1 to 4, 7, 8, 9, 12 to 15 and 31 are each rejected as vague and indefinite and hence failing to comply with Section 4888 R. S. Certain of these claims indicate that flux components are acid and basic and that chemical reaction therebetween has been previously completed. Such being [fol. 1194] the case it appears that the flux, per se, is neither acid nor basic nor that it is apparent from inspection of that flux as to what were its original component elements. Further, even if such recitations were definitive, it does not appear that just any such flux will give rise to results desired and which results will accrue when a flux disclosed by the applicant is used. In claims 3 and 4 the whereby clauses do not at all follow from erstwhile recited steps. Nor has the applicant shown that just any nonmetallic material (with or without negative limitations) can be used in his process. The *use* of the composition of claims 12, 13 and 15 cannot be of materiality in a true definition of the composition. Art is applied accordingly. In claim 31 it is immaterial as to what is absent from the process. What are the affirmative steps, as disclosed, that lead to desired results?

Claim 11 is rejected as fully anticipated by each of Robinoff and Lincoln or any alternating current arc welding where a flux is placed on the seam. Obviously the arc must

be reestablished between alternations and this will occur of necessity if arc welding is to be performed.

Claims 13, 14 and 15 are each further rejected as unpatentable over Severance, the negative limitations being disregarded for purposes of application of this reference.

Claims 5, 6, 10, 16 to 27 and 32 to 38 are allowable as at present advised.

R.L.S.

R. L. Glass, Examiner.

[fol. 1195] [Stamp:] Mail Division, U. S. Patent Office, Apr. 18, 1936.

In the United States Patent Office

Div. 60, Room 5896

Serial No. 44,142, Filed October 9, 1935

L. T. Jones, H. E. Kennedy and M. A. Rotermund.

Electric Welding

Hon. Commissioner of Patents, Washington, D. C.

Sir:

In response to the official action of January 15, 1936, the above-entitled application is hereby amended as follows:

Cancel claims 1 and 2.

Claim 3, line 7, after "material" (*first* occurrence) insert:

B1 —which acts as a high-resistance conductor at welding temperatures and which does not evolve sumstantial amounts of gas when in contact with the melted weld metal,

Claim 3, line 8, change "whereby" to: —*to avoid*—.

Claim 3, last line, change "gas" to: —*air*—.

Claim 3, last line, change "is avoided" to: —*between the electrode and work piece*—.

Claim 4, line 9, change "whereby" to: —*to avoid*—.

Claim 4, last line, change "gas" to: —*air*—.

Claim 4, last line, change "is avoided" to: —

B1 between the electrode and work piece; said nonmetallic material being one which acts as a high-resistance conductor at welding temperatures.

Claim 5 follows.

Claim 10, last line, change "medium" to: —*composition*—.

Cancel claims 11, 12, 13, 14, 15.

Claim 16, line 1, cancel "arc."

Claim 27, line 9, change "iron" to —*uncombined iron oxide*—.

[fols. 1196-1222] Cancel claims 28, 29, and 30.

Claim 31, lines 7 and 8, cancel "nonmetallic material" and insert therefor: —*silicate*—.

Claims 33, 34, 35, 36, 37, and 38, line 4 of each, before "said member" insert: —*and in contact with*—.

Add the following new claim:

Per C.

B³ 1. [39. (To appear as claim 1)] * The process of electric welding which comprises the steps of juxtaposing an electrode and a conductive member on which metal is to be deposited; establishing between said member and said electrode a conductive path of a high-resistance melt of chemically stable [inert] * fusible material having at welding temperatures substantially the fluidity and electrical conductivity of a fusible silicate, and substantially free from substances capable of evolving large amounts of gases during welding; passing through said melt an electric current of sufficient strength to maintain its conductivity, progressively melt the required amount of metal, and cause the resulting molten metal to coalesce with said member; and maintaining said melt in contact with said electrode throughout the welding operation to avoid the formation of a substantial air-conducted electric arc between the electrode and the said conductive member.

Add D. Cl. 2>

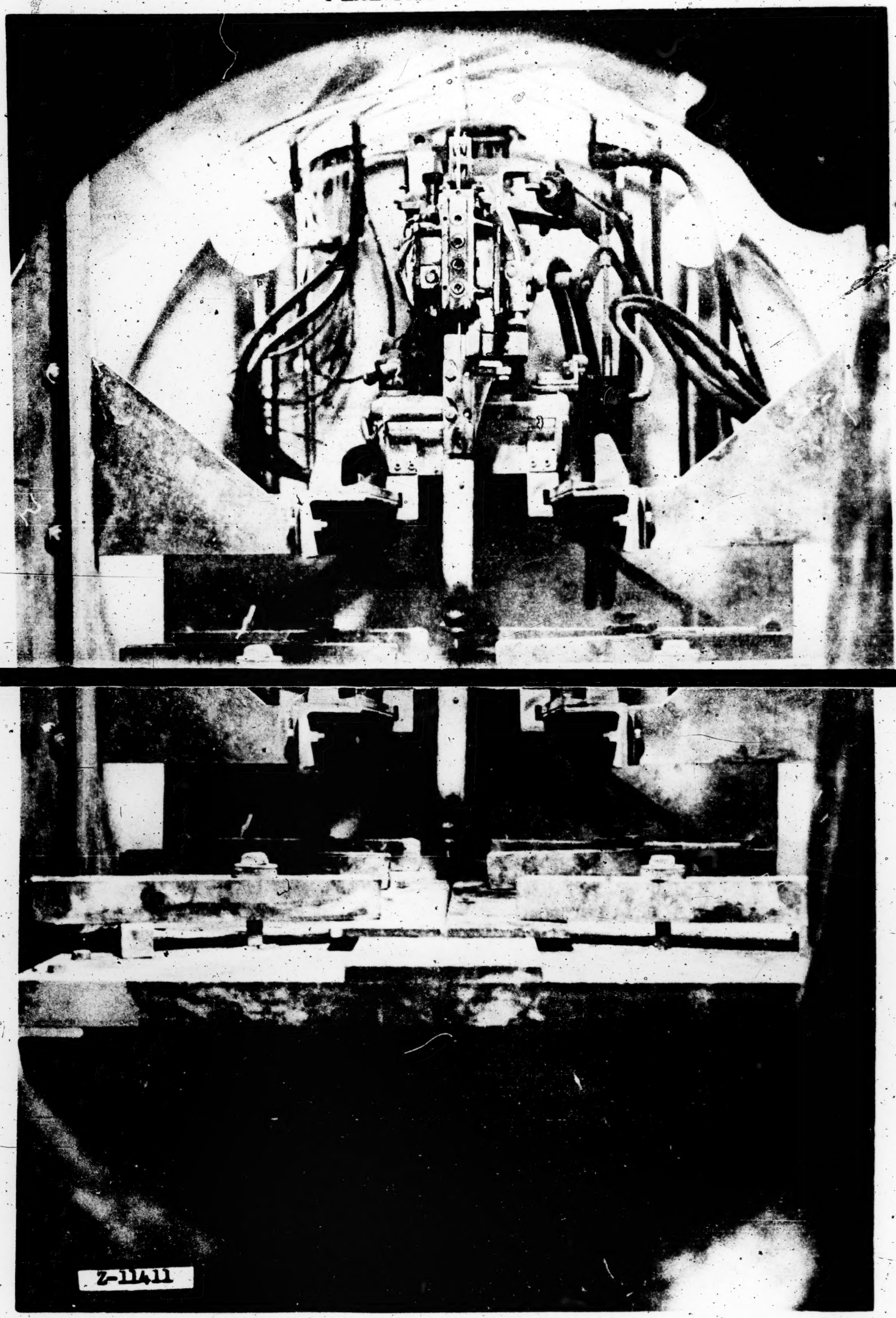
[*Words and figures enclosed in brackets erased in copy.]

Remarks

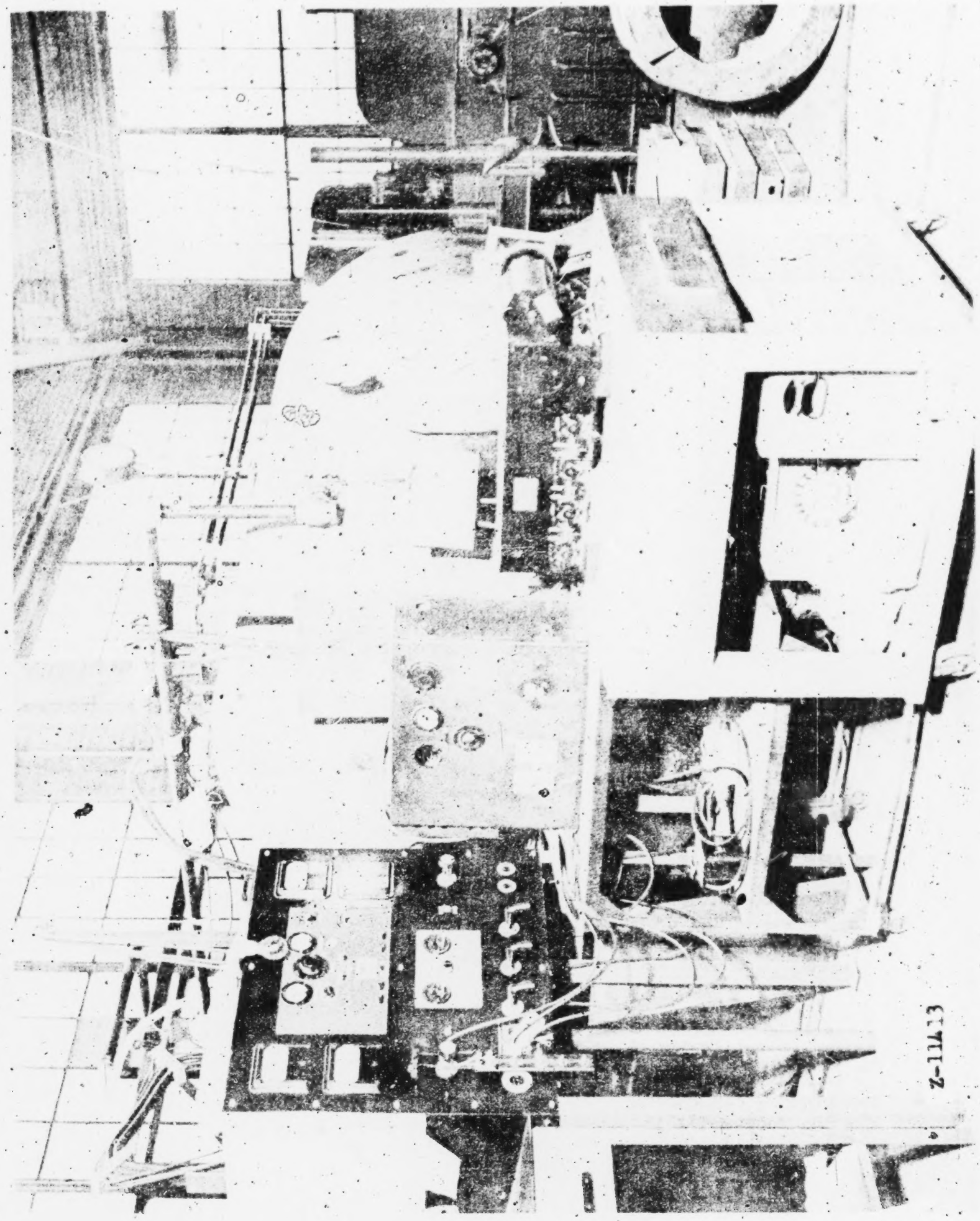
Rejected claims 1, 2, and 11 through 15 have been cancelled. Also, claims 28, 29, and 30 are cancelled and are now being presented in applicants' copending divisional application Serial No. 68,300, filed March 11, 1936.

(Hele follows 3 Photolithographs, side folios 1223-1225)

PLAINTIFF'S EXHIBIT 175-A



PLAINTIFF'S EXHIBIT 175-C



Z-11433

[fol. 1226] PLAINTIFF'S EXHIBIT 216-S

UNIONMELT WELDING PROCESS

License Agreement

[fol. 1227] This License Agreement, made and entered into this day of , 194 , by and between The Linde Air Products Company (hereinafter called the "Licensor"), a corporation organized and existing under the laws of the State of Ohio and having an office at 30 East 42nd Street in the City of New York in the State of New York, party of the first part, and (hereinafter called the "Licensee"), a corporation organized and existing under the laws of the State of having an office at in the City of in the State of party of the second part,

Witnesseth:

Whereas, the Licensor is the owner of, or the licensee (with the right to grant sub-licenses) under, Letters Patent of the United States of America, numbered as follows:

1,782,316	2,269,538	2,294,439
2,043,960	2,275,910	2,308,194
2,145,009	2,278,569	2,326,865
2,152,194	2,280,150	2,330,289
2,200,737	2,293,163	2,331,937

all relating to a process of electric welding and/or compositions of matter covered by certain claims of certain of said Letters Patent (therein sometimes referred to as a welding composition and hereinafter called by Licensor's trademark "Unionmelt") for use in the practice of such process; the said Letters Patent and any and all Letters Patent of the United States of America relating to any and all improvements within the scope of any claim thereof, made, acquired, owned, or controlled by the Licensor, and any and all reissues thereof, and the inventions set forth in the claims thereof being hereinafter collectively called "Unionmelt Patent Rights" and the said process, with any and all im-

provements thereto, being hereinafter called the "Unionmelt Welding Process"; and

Whereas, the parties hereto are desirous that licenses under the Unionmelt Patent Rights shall be granted by the Licensor to the Licensee, upon and subject to the terms, conditions and agreements hereinafter set forth;

Now, therefore, for and in consideration of the premises and of the mutual agreements hereinafter set forth, the parties hereto hereby mutually agree as follows:

[fol. 1228] Article I

The Licensor hereby agrees:

Section 1. To give and grant, and it does hereby give and grant, to the Licensee, during the period (hereinafter called the "License period") beginning with the 1st day of ....., 194 , and ending June 9, 1953 a non-exclusive, non-assignable license under all welding process claims contained in the Unionmelt Patent Rights, to use the Unionmelt Welding Process in all plants in the United States operated by the Licensee and also a concurrent non-exclusive, non-assignable license under all welding composition claims contained in the Unionmelt Patent Rights, to use in such plants, but not to make, Unionmelt covered by such welding composition claims.

Section 2. Unless prevented by a shortage in manpower beyond the Licensor's control, to furnish to the Licensee, upon its request in writing, the services of a competent engineer familiar with the Unionmelt Welding Process and the equipment required, for use in connection therewith and the operation thereof, to assist in supervising the design and construction of such equipment (other than Unionmelt welding heads with the necessary automatic control equipment for feeding welding rod electrodes, such automatic control equipment being hereinafter included in the term "Unionmelt Welding Heads"), the installation of all such equipment, the putting the same into operation, and the operation thereof, for such period of time, not to exceed three (3) months, as may be reasonably necessary therefor.

Section 3. To sell and deliver or cause to be sold and delivered, f.o.b. plant of manufacture, any Unionmelt, and any Unionmelt Welding Heads or parts thereof which the

Licensee may desire to purchase for its use during the license period, the Unionmelt of grades suitable for use in the welding of steel products at the price of four and one half cents ($.045) per pound f.o.b. plant of manufacture, and the Unionmelt Welding Heads and the Unionmelt of grades suitable for use in the welding of materials other than steel at standard prices established by the Licensor, all subject to the provisions of Section 1, Article III hereof plus the amount of any sales or other excise taxes imposed on Licensor by reason of any such sales or deliveries.

Section 4. Promptly to advise the Licensee with respect to any United States patents involving substantial improvements to the Unionmelt Welding Process hereafter acquired, owned, or controlled by the Licensor during the license period.

Section 5. To defend or settle, at its own expense, any suit or action which may be brought against the Licensee, and or any purchaser or user of such steel products so welded, for alleged infringement in the United States of the patents of others by reason of the use (in so far as such use is in accordance with the instructions of the Licensor) by the Licensee of the Unionmelt Welding Process or of Unionmelt during the license period and to indemnify and hold harmless the Licensee and/or any such purchaser or user from and against all damages and costs which may be adjudged or decreed against the Licensee and/or such purchaser or user in any such suit or action and be actually paid by the Licensee and/or such purchaser or user; pro- [fol. 1229] vided, however, that the Licensee shall have given prompt notice in writing to the Licensor of any claim of such alleged infringement and the bringing, or any threat of the bringing, of any such suit or action and shall permit the Licensor, or cause the Licensor to be permitted, by its counsel to defend or settle the same; and provided, further, however, that neither the Licensee nor any such purchaser or user shall settle or compromise any such suit or proceeding without the prior consent in writing thereto of the Licensor.

Article II

The Licensee hereby agrees:

Section 1. To accept, and it does hereby accept, the Licenses hereby granted, for the license period, upon terms and conditions herein set forth.

Section 2. To pay the Licensor, as license fees hereunder, five cents ($.05) per pound on each pound of metal deposited by the Licensee by the use of the Unionmelt Welding Process, subject to the provisions of Section 1 of Article III hereof; such payments to be made on all metal so deposited during each quarter-yearly period ending on the last days of the months of March, June, September, and December of each year of the license period, within thirty (30) days after the expiration of such respective quarter-yearly periods; and to render to the Licensor within such thirty (30) days a statement in writing showing the amounts (weights) of metal so deposited during such preceding quarter-yearly period, and the computation of license fees payable to the Licensor hereunder for such period.

Section 3. To keep true books of account containing an accurate record of the amounts (weights) of all welding rod electrodes purchased by it for use in the Unionmelt Welding Process, during the license period, of the amounts (weights) of all welding rod electrodes so used during such period, and of the amounts (weights) of all metal so deposited during such period; and to permit the Licensor, at its request, to examine, at all reasonable times by its duly authorized representatives, such books of account to such and only such extent as may be reasonably necessary to enable the Licensor to check and determine the accuracy or inaccuracy of such statements in writing to be rendered under the provisions of Section 2 of this Article II.

Section 4. To pay the Licensor or its nominee, within thirty (30) days after receipt of the respective invoices therefor, for all Unionmelt and all Unionmelt Welding Heads sold and delivered or caused to be sold and delivered by the Licensor hereunder, the respective prices therefor specified in Section 3 of Article I hereof and/or referred to in said Section 3 of Article I.

Section 5. To pay the Licensor, promptly upon receipt of bills therefor, at the rate of Fifteen Dollars ($15.00) per day for the services of the engineer furnished by the Licensor under the provisions of Section 2 of Article I hereof, for such time as such engineer shall spend outside his usual place of employment in rendering such services, together with the reasonable traveling and living expenses of such engineer during such time as he shall be so engaged in such work, to be computed from the time he leaves his usual place of employment until his return thereto.

[fol. 1230] Section 6. All agreements herein relating to sales and deliveries hereunder are subject to and contingent upon acts of God, governmental orders or regulations, wars, invasions, riots, strikes, fires, accidents, inability to obtain or delay in obtaining sufficient or suitable necessary materials or equipment, lack or delay of transportation facilities, and other similar or different contingencies beyond the reasonable control of the Licensor.

Section 7. To notify the Licensor in writing whenever Licensee proposes to use the Unionmelt Welding Process in any of its plants other than its plants at

Article III

Both of the parties hereto hereby agree:

Section 1. That because of the fact that financial, and/or labor conditions, and/or price measures or regulations of the Government may hereafter operate to change the domestic purchasing value of the dollar and/or to change generally costs of production, thereby rendering it equitable that the rate of license fees and the price of Unionmelt herein provided for should be increased or decreased and because of the impossibility of ascertaining such causes and measuring the effect thereof, it is therefore mutually agreed that in the event, for any cause whatever, the average of the market prices of hot rolled sheets, hot rolled strips, plates, and structural shapes, as published from time to time under the caption "Comparison of Prices", in "The Iron Age", by the Chilton Company, Inc., shall for any quarter-yearly

period ending on the last days of the months of March, June, September, and December of any year of the license period, be more than or less than the average price (hereinafter called the "base price") of 1.825¢ per pound, by one or more units of 10% each of the base price (fractions of a unit to be disregarded), then for the next succeeding quarter-yearly period such rate of license fees and such price per pound of Unionmelt of grades suitable for use in the welding of steel products, shall be increased or decreased from the rate and price hereinbefore provided for, by the same number of units of 10% each of such rate and price; provided, however, that in the event the publication of such prices by said "The Iron Age" shall be discontinued, then any generally recognized source of market prices of these items of finished steel, shall be used as the measure, for the purposes of this Section 1. The provisions of this Section are subject to all applicable governmental orders and regulations.

Section 2. That in the event all claims, essential to control commercial operation of the Unionmelt Welding Process, in patents which may have been allowed at the time with respect to the Unionmelt Welding Process shall be declared invalid by the decision, unappealable or unappealed, of a court of the United States having jurisdiction in the premises, then and in that event the Licensee shall have the right at any time thereafter, at its option and upon notice in writing given to the Licensor, to terminate the licenses herein granted.

[fol. 1231] Section 3. That in the event of the failure of either party hereto to carry out its obligations hereunder, the party not in default may give to the other party notice in writing of its failure so to comply with its said obligations, and unless such failure shall be remedied within thirty (30) days after the giving of such notice in writing, then the party not so in default may, at any time thereafter, by notice in writing given to the other party, terminate this agreement and the licenses herein granted.

Section 4. That it shall be a sufficient giving of any notice or other communication in writing hereunder if the party desiring to give such notice or other communication in writing shall deposit a copy of the same in the Post Office in a registered envelope duly addressed to the other party

at its said office, or at such other address as the other party hereto shall have theretofore in writing requested the party desiring to give notice or other communication in writing to address the same. The date of the giving of any such notice or other communication in writing shall be and be held and construed to be the date on which said copy shall have been deposited in the Post Office in a registered envelope duly addressed as aforesaid. The Post Office registry receipt showing the deposit of such envelope and the date of such deposit shall be prima facie evidence of these facts.

Section 5. That all statements in writing to be rendered and all payments to be made hereunder to each party hereto shall be rendered or made, at such address as such party shall from time to time designate.

In witness whereof, the parties hereto have caused this instrument to be executed by their respective officers thereunto duly authorized, as of the day and year first hereinabove written.

The Linde Air Products Company, by —— ——,
Vice-President.

[fols. 1232-1237] PLAINTIFF'S EXHIBIT 217

September 10, 1943.

Mr. J. F. Lincoln,
The Lincoln Electric Company
12819 Coit Road
Cleveland, Ohio.

DEAR JIM:

I have your letter of September 6th regarding the subject we have discussed several times. I feel sure that you are misinformed regarding alleged threats made by us to your customers. I have not made such threats personally and I am sure that no one in our organization has made threatening statements. If you know of any actual instances, I would be interested in receiving this information.

Our position with respect to these matters is exactly as I outlined to you in our discussions at Cleveland in the early part of April, which was confirmed by my letter of April 13th. I think this procedure is clear and as far as I knoow we have not deviated in any way from our program as outlined to you. You, of course, realize that our actions in these matters may be changed at any time we desire and

that these actions are based upon the fact that we are so fully engaged in war work that we cannot devote time to purely private controversies.

We have received information from unimpeachable sources that you and your associates are advising our licensees that they may disregard our license agreement and that it will not be necessary for them to pay any more license fees to us. I think this is putting the shoe on the other foot and am surprised that such statements can be attributed to you and your representatives. I can assure you that we expect our licensees to pay license fees as long as they operate within the scope of our patents under which they have a license.

I also understand that your representatives have been reported to have told a number of individuals that a patent suit is in progress. This information is not only false, but is misleading to the people concerned.

It is impossible for us to answer the question raised in the last paragraph of your letter as I have not seen your welding process in operation. I feel sure that you have a complete set of our various patents as you showed them to me one time in your office, and I believe that you should be [fol. 1238] in position to determine what patents if any are being infringed, as you know what operations are being carried out.

We have repeatedly told our licensees that they are perfectly free to buy any materials or equipment they desire from you or any other manufacturer and, as far as that goes, we have gone even further than that and recommended that they buy such equipment and materials if they felt they were superior to what we are offering for sale. It is no more than fair, however, that we should expect our licensees to live up to their agreements with us and it is certainly a disturbing influence for anyone to recommend to our licensees that they disregard their agreements with us.

I have endeavored to carry out all our discussions of this matter in complete frankness and friendliness and this spirit will always prevail. It would seem that your organization is the one that is acting "intolerable" rather than ours, particularly if you are advising our licensees to disregard our license agreements. I will be glad to discuss

this subject fully and as frankly as ever any time you are in New York or when I am next in Cleveland.

With kindest personal regards, I am,

Very truly yours, R. E. Cornwell.

R. E. Cornwell/k.

[fol. 1239] PLAINTIFF'S EXHIBIT 218-G

OXWELD RODS FOR UNIONMELT WELDING

Purchase Contract

[fol. 1240] Whereas, the Linde Air Products Company, an Ohio corporation, (hereinafter called the "Seller") desires to sell and

a corporation of , (hereinafter called the "Buyer") desires to purchase bare rod electrodes for use as hereinafter provided and upon the terms and conditions hereinafter set forth;

Now, therefore, in consideration of the premises and of the mutual and dependent promises hereinafter stated, the parties hereto mutually agree as follows:

1. The Seller agrees to sell and deliver, and the Buyer agrees to purchase and take delivery of, f.o.b. plant of manufacture or Seller's warehouse, at Seller's option, the Buyer's entire requirements of bare rod electrodes for use in a process of electric welding known as the Unionmelt Welding Process (but sometimes designated by other names, being the process described in Chapter 7 of the 1942 edition of the American Welding Society's "Welding Handbook") for the period of one (1) year beginning on the day of 19 and continuing after said period from year to year until cancelled at the end of any then current contract year by notice in writing to that effect given by either party hereto to the other not less than sixty days prior to the end of such then current contract year.

2. The bare rod electrodes to be sold and delivered hereunder (hereinafter called "Oxweld Rods") shall, unless hereafter otherwise mutually agreed upon, and subject to the provisions of paragraph 3 hereof, be special coiled or straight lengths of bare rod electrodes, of the grades, lengths, and weights, shown on the schedule hereto attached, marked "Exhibit A".

3. The Seller shall have the right to discontinue the sale of one or more of the grades of Oxweld Rods listed on Exhibit A, provided the Seller shall continue to make available for purchase hereunder, an Oxweld Rod equivalent or superior in quality to, and at the same price as, the grade of Oxweld Rod so discontinued.

4. It is mutually agreed that the prices of said Oxweld Rods shall be fixed for each calendar quarter-yearly period of this agreement, or part thereof, as provided in paragraph 5 hereof, but shall in no event be less than the respective prices (hereinafter called the base prices) of the respective grades, lengths, and weights, listed on Exhibit A. Such prices shall be f.o.b. plant of manufacture or Seller's warehouse at Seller's option. There shall also be added to such base prices the amount of any sales or excise taxes imposed upon the Seller by reason of sales or deliveries of said Oxweld Rods except such taxes as apply to manufacture or production.

[fol. 1241] 5. The prices of said Oxweld Rods shall be computed for each calendar quarter-yearly period of this agreement, or part thereof, by adding to the respective base prices, an amount equal to the amount that the average of Pittsburgh, Penna., quoted prices per pound of bright wire as published from time to time under the caption "Prices of Finished Iron and Steel" in "The Iron Age" by the Chilton Company, Inc., during the next preceding calendar quarter-yearly period may exceed 2.30¢ (the average per pound price of plain wire corresponding to the base prices for Oxweld Rods); *provided, however*, that in the event the publication of such average quoted prices per pound by "The Iron Age" shall be discontinued or changed in form or character, then the nearest reasonable equivalent thereof showing the average market prices per pound of bright wire shall be used as a basis for determining the prices of Oxweld Rods hereunder.

6. Terms shall be net cash within thirty (30) days after receipt of invoices.

7. All agreements herein relating to sales and deliveries hereunder are subject to and contingent upon acts of God, governmental orders or regulations, wars, invasions, riots, strikes, fires, accidents, inability to obtain or delay in obtaining sufficient or suitable necessary materials or equip-

ment, lack or delay of transportation facilities, and other similar or different contingencies beyond the reasonable control of the Seller.

8. This Agreement shall become effective only when signed by the Buyer, and accepted in writing by the Seller, either at the Division Office or at the New York, N. Y. Office of the Seller, by the Sales Manager or by some other person authorized to accept such agreements. No change in or addition to the terms and provisions hereof shall be made unless approved in writing in like manner.

9. This Agreement shall be assignable by the Seller to any corporation controlled by Union Carbide and Carbon Corporation.

The Linde Air Products Company, Submitted by ——, (Seller's Representative), Date ——. Accepted —— ——, (For the Seller), Date ——.

[fol. 1242] Exhibit A

Base Prices of Oxweld Rods for Unionmelt Welding

	Oxweld No. 35 per lb.	Oxweld No. 36 per lb.	Oxweld No. 40 per lb.
16-foot Straight Lengths	$0.065	$0.073	——
150-pound Coils	0.060	0.068	$0.078
25-pound Coils	0.065	0.073	0.083

[fol. 1243] Plaintiff's Exhibit 219

The Lincoln Electric Company
Shield-Arc Welders—Fleetweld Electrodes
Line-Weld Motors—Welding Supplies
12818 Coit Road, Cleveland, Ohio

Date October 8, 1941.

In reply refer to: J. F. Lincoln.

Mr. R. E. Cornwell,
The Linde Air Products Company,
30 East 42nd Street,
New York, N. Y.

My Dear Sir:

I have been up in Canada shooting a few innocent birds since I saw you and discussed the question of your com-

pany's infringement of our J. C. Lincoln Patent #1,589,017. I have just returned to my desk.

Upon taking up this matter we find that you have several patents covering the use of welding under a deep flux in which from your point of view there may be some chance of conflict. We are advised by our attorneys that our flux and method of welding in no way conflicts with any issued patents. However, as I made clear to you, I do not want to spend a good deal of my future life, which is now drawing rapidly to a close, in fighting a silly patent suit which could be expensive, time consuming, and utterly nonsensical.

Therefore, I have requested our attorneys to draw up a simple form of cross-license, which if consummated would relieve us both of possibility of patent conflict over use of such deep flux.

We are not interested in licenses as such—we merely want to be free from attack under these patents when we use a deep flux welding process which we have developed, and to this end are willing on our part to forego assertion against you of the rights we have been granted under our own dominating patent.

Will you accordingly please give immediate consideration to the enclosed copy of draft agreement which we have had prepared as noted above. I believe this embodies the spirit of what I am suggesting, but shall be glad to discuss any changes you may have to suggest.

Yours very truly, The Lincoln Electric Company,
J. F. Lincoln, President.

JFL–LL

[fol. 1244] PLAINTIFF'S EXHIBIT 220

Memorandum of agreement entered into this —— day of ——, 1941, by and between:

The Lincoln Electric Company, of Cleveland, Ohio, a corporation of Ohio, hereinafter for convenience referred to as Lincoln, Party of the First Part; and

Union Carbide & Carbon Corporation, of New York City, New York, a corporation of New York, hereinafter for convenience referred to as Union, Party of the Second Part.

Witnesseth: That

Whereas, Lincoln owns certain patent rights (hereinafter

referred to as "Lincoln Patent") relating to "separate flux welding", as hereinafter more particularly defined, to-wit:

U. S. Patent No. 1,589,017 to J. C. Lincoln, dated June 15, 1926; and

Whereas, Union owns patent rights (hereinafter referred to as "Union Patents") relating to such "separate flux welding", to-wit:

No. 2,043,960 to Jones et al, dated June 9, 1936; 2,145,009 to Keir dated Jan. 24, 1939; 2,150,625 to Jones et al dated Mar. 14, 1939; 2,152,194 to Jones dated Mar. 28, 1939; 2,189,399 to Lewbers dated Feb. 6, 1940; 2,200,737 to Clapp dated May 14, 1940; and

Whereas, Lincoln and Union, in order to avoid litigation and promote the use of "separate flux welding" as thus defined, are desirous of exchanging licenses under such patent rights.

Now, therefore, in consideration of the mutual covenants of the parties hereto, and other good and valuable consideration, it is hereby agreed by and between the parties as follows:

I. Definitions

For the purpose of this agreement, the following terms shall have those meanings respectively ascribed thereto:

[fol. 1245] 1. The term "separate flux welding" whenever used herein shall mean any process of electric welding in which an electrode is maintained in spaced relation to the work with a flow of heating current across such space, and in which the seam is filled with, or either or both sides of the work along the line of travel of the electrode is covered by, a flux or slag forming material derived from any source other than a coating on said electrode.

2. "Compositions" shall mean any flux or slag forming material per se, or the mode of manufacture thereof, useful in such "separate flux welding process."

3. "Apparatus" shall mean any apparatus useful only for the purpose of carrying out the "separate flux welding process."

4. "Subsidiaries" shall mean all the corporations of which the parent company owns directly or indirectly more than fifty per cent (50%) of the stock having the right to vote for directors. For the purpose of this definition, the

stock owned by the parent company shall be deemed to include all stock having the right to vote for directors and owned directly or indirectly by any of its "subsidiaries" as thus defined.

II. Grants

1. Lincoln hereby grants to Union under "Lincoln Patent" the following royalty-free, non-exclusive, irrevocable license:

(a) To practice the "separate flux welding process";
(b) To manufacture, use and sell any "compositions";
(c) To manufacture, use and sell "apparatus"; and
(d) To sub-license purchasers from Union of any "composition" or "apparatus" to use the same in the "separate flux welding process."

2. Union hereby grants to Lincoln under "Union Patents" the following royalty-free, non-exclusive, irrevocable license:

(a) To practice any "separate flux welding proc- [fol. 1246] ess"; (b) To manufacture, use and sell "compositions"; (c) To manufacture, use and sell any "apparatus"; and (d) To sub-license purchasers from Lincoln of any "composition" or "apparatus" to use the same in the "separate flux welding process."

III. General Provisions

1. The term of this agreement shall extend to the end of the term of the last to issue of patents hereinafter listed.

2. In the event of liquidation, receivership, bankruptcy, or insolvency of one party, or any assignment by such party for the benefit of creditors, the other party shall have the right to cancel this agreement by giving ten (10) days written notice.

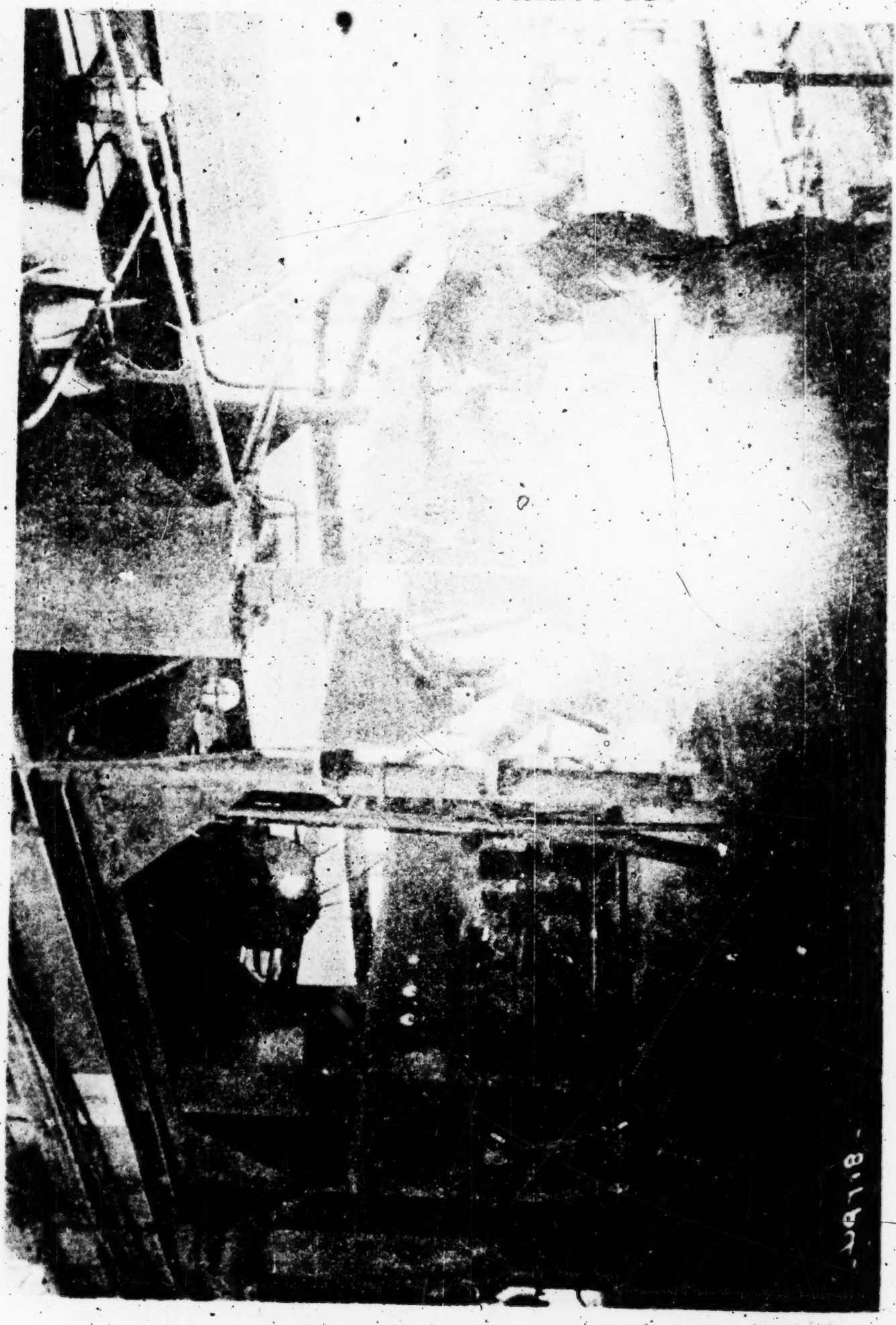
3. This agreement shall be binding upon and insure to the benefit of the parties thereto, their successors and assigns; however, neither party may transfer this agreement or the license hereinunder given except to a successor to its entire business, without the consent of the other party first secured in writing.

In witness whereof, the parties hereto have caused this agreement to be executed in duplicate as of the day and

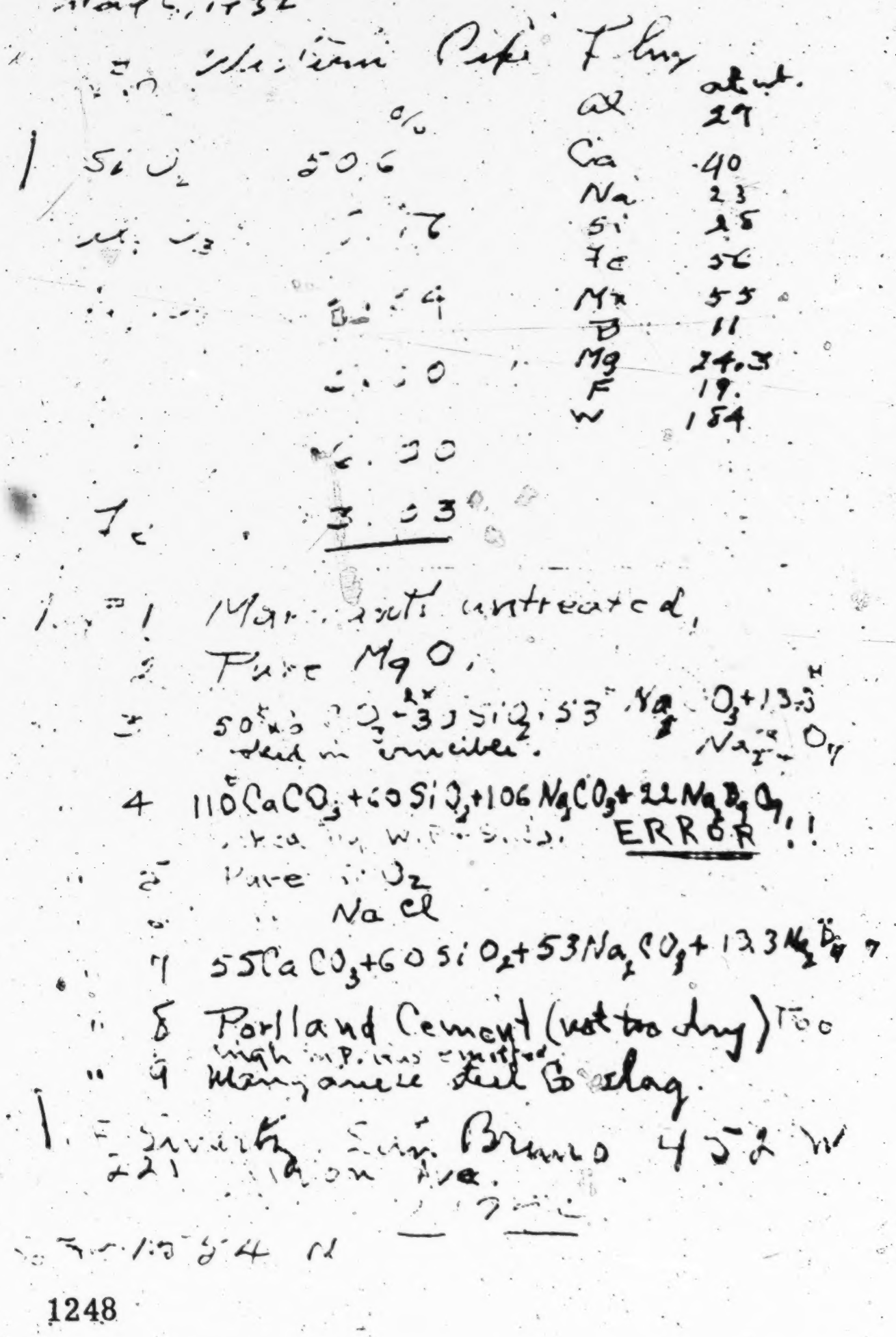
year first above written by their officers thereunto duly authorized.

The Lincoln Electric Company
Attest: ——— ———, Secretary. By ——— ———, President.
Union Carbide & Carbon Corporation
Attest: ——— ———, Secretary. By ——— ———, President.

PLAINTIFF'S EXHIBIT 225-A



DEFENDANTS' EXHIBIT 88



7 Lumps

8. Universe are at normal flame lighting but not much gas emitted.

7. Flux clay fuses brighter than with #1 flame very slightly more than with flux #1 but is actually same appearance

7A Flux is #7 remelted in electric furnace. Its flame longer than flux #7 lighted. None until lighted.

9. Flame double size of #1. Not so quiet in operation as #1. Flux clay very high, narrow & irregular — no glassy appearance at all. Acts like very infusible flux.

7B Flux is #7 melted entirely in electric furnace. on June 4th

10 Prepared in elec. furnace June 4th

11. Flux high melting but not so much as #9. Flame 4 match.

1250

Composition of Charges

No.	Cr_2O_3 100	SiO_2 60	TiO_3 106	Fe_2O_3 232	$Na_2B_4O_7$	CaO
10	20	12.7	*	2.5	2.5	
11	-	-	-	-	-	Columbia Steel Co.
12	50-50 mixture by vol. of #10 and 7B					
14	20	12.7 (Cold 5 lbs. of #7)		2.5	2.5	
15	mixture of every thing, W.P.S. 65 #; #7-20 #.; $FeSO_4$ 10 #.					
16	20	12.7	—	2.5	2.5	
17	20	12.7	—	2.0	2.0	
18	20	12.	—	—	2.5	
19	40	26.1	—	7.5	2.5	
20	20	12.7	—	(2.5+4)	—	

* Trace from melting in electric furnace after #7B

21 WP+ - 1 # merely melted, also barely slag ltd

16 Flint

Start of heat

E = 65

I = 3.5 x 160

R = .115

Increased Reactance

E = 64

I = 1.8 x 160

R = .223

E = 68

I = 1.6

R = .225

added B

I = 1.4

E = 74

R = .330

#17

73

1.4x160

68

1.6

1252

Composition of Fluxes.

	*100	CO				
22	20	12.7	–	2.5	5.0	
23	20	12.7	–	2.5	10.0	Slag sticks very tight even at 900 cents.
30	11.2 Poghiera	2.7	–	2.5	2.5	Blue, good flux, lots of cracks at high volts
31	30 Poghiera	25.4	–	5.0	5.0	Greenish
32	10 WPG CaO	12.7	–	2.5	2.5	Baby Blue.
33	67.2 Danish	76.2	–	15.0	15.0	melted in WPGS Co. oil furnace – Black.
33A	second melt of 33, Less residue of 15 in Furnace.					
34	L.C.					
35	33.6 Danish	38.1	–	–	7.5	Yellow flame behind arc. No flame at wire. White like zinc on nozzle.
			7/2			
36	42	30	[redacted]	–	6	Greenish Blue. Oil furnace.
37	20	23	$H_2B_4O_7$ 4.5	4.5	–	
[redacted]	30	34 1/2	4.75	4.75	–	Lime

38	$CaCO_3$	SiO_2	Fe_3O_4	HB_2O_3 or $H_2B_4O_7$.	M
39	50 Danish	35.25	6.25	7.0	Oil fired.
40	Metath	$CaCl_2 + Na_2SiO_3 \rightarrow$	$BaSiO_3 + 2NaCl$.		Dried at red heat.
41	N 41° Be	—	30 "i	30	— { Exceedingly friable and powdery. Black. Very low melting. Sand blasts
42	#40 plus 25% (weight) Boric anhydrid. 10 matches flames above flux in welding 305.				
43	75	45 + { FeO 9.37 / SiO_2 7.8 } less 7.1 lbs.		— 10.5 — less 7.37	{ A, B, C, for oil / final mats A, B, C, / All same mix.
43F	CaF_2 added to 43 sintered and again ground.				
44	Natural $CaSiO_3$ from Nafa.				
~~45~~	~~40.0~~	~~24.0~~			~~electric pot (new pot)~~
45	Ground slag from flux 43 (pipe welds).				
46	1 part Fe_3O_4, 3 parts SiO_2 (sand blasting sand) electric pot.				
47	Sodium silicide from Phil. Quartz Co. Solid glass kind.				
48	Mixture of 70% #43; 30% #45.				
50	Same as #47 plus 30% SiO_2 + %				Na_2SiO_3 & $H_2B_4O_7$

1253

1158

1159

Notes: Aug 5

43 flux on 7/16" plate at 15"/min 825 amp. voltages of 30 - 32.5 - 34.5 all gave good penetration no increase in surface width with volt increase + increase in surface holes with volt increase

5) 43 flux on 7/16" plate at 28 volts 770 amp speeds of 15 - 13 - 11"/min and one tap increase in reactance gave insufficient penetration but flatter welds from 1/2 to 17/16" a few small holes good structure + tough hard to break welds.

3) 43 flux on 7/8" plate at 28 volts 770 amps 11"/min good tough weld - good grain 13/16" wide.

4) 43 flux on 7/8 plate [1/2 plate at 35 volts each 1/2 at 28 but bottom surface not ground off. - Jack broke at finish end at 35 volts. Slight end 11/8 wide.

5) 43 flux 7/8 plate 31 1/2 volts 11"/min (apparently with less heat arc is nearer center of plate than the child bar and an increase in voltage gives a flatter weld

#2 flux - 28 volts with feed motor slowed down no chat mag. deck thickly responded (no change in weld appearance - no wider when main sw opened wire fuse to weld at surface.

(3) $3SiO_2 + 1\ Fe_3O_4$ + [illegible] part - black flux came off light (thin) slag. flat weld (bad no slag against chill bar. Metal ran [illegible] although only 1/32" separation holes through at points of slight amount of slag. Decided ripple on weld not mag. [illegible] - electrode at surface of plate -

(4) Flux #3 [illegible] gave [illegible] slag fall off easier. weld looked like #3 flux (on plate) & under side same. Some [illegible] Looks like $CaSiO_3$ M.P. by itself as a flux

	Dar..sh. $CaCO_3$	MgO	SiO_2	Fe_3O_4	$H_2B_4O_7$ H_3BO_3 $+H_2O$	How melted	
51	10.56	8.45	25.6	-	-	Electric	{CaO 14.8 % MgO 21.2 " SiO_2 64 "}
52	21.9	-	5.11	-	-	Electric	Kaolin 15 (Seeker p.73)
53	40		24			Oil	$CaSiO_3$
54	8 lb. of 53 with added 5% Boric anhydrid.						
55	4 lb. of 53 with added 5% of 48.					Oil	Same as 51 except oil
56	10.56	8.45	25.6				
57	10.56	8.45	25.6			Oil	CaF_2 5.0 Aug 24, 1932.
58	4 lb. of 53 plus 2.75 oz of Aluminum.						
57A	Same as 57 with 5% CaF_2 added just before pouring. F. not out. More glassy and more friable. * 57 looks like 49 brick inside.						

No holes in slags 57 or 57A

Flux No	Dansk $CaCO_3$	Pure MgO	Finely ground SiO_2	Fe_3O_4	Al_2O_3	MnO_2		CaF_2	Na_2SiO_3	Molybdenum Material	Fusion	Heat to slag.	
59	10	lb. of	43	plus	2	lb.	CaF_2	mixed,	not	fused.			
60	33	–	20	–	–	–	–	5	–		Oil	None	
61	33	–	30	–	–	–	–	5	–		Oil	"	poured Sep. 5
62	33	–	40	–	–	–	–	5	–		Oil		" Sep. 9
63	33	–	60	–	–	–	–	–	–		Oil		Definitely slow " Sep. 17
64	10	[illegible]	25.6	–	–								
65	–	25.0	–	–	–	–	–	5	–		Not fused. Oil–Castor oil melt.		
66	50	–	30	–	–	–	–	20	–				
67A	same as 60 with copper from burner added.												
67B	"	"	"	" less copper	"	"		"					
68	50	9.4	40.5			↓		14				Six Tongues + mixture.	
69	50		30					6					
70	–	–	60	–	–	100	–	0	–		Oil	1 oz in 1 lb CaF_2 mixed cold.	

1257

1162

1258

Flux No	Dansk $CaCO_3$	Pure MgO	Iron free SiO_2 & Fe_2O_3	Al_2O_3	CaF_2	Method of Fusion	
72	66% #68	plus 32% #70			usual	cold	CaF_2 in 68 only.
73	Flux 72	with 20% Calcium	carbide added			cold.	

1163

Flux Analyses.

	Original W.P.+S. Co.	For 2nd Pass. W.P.+S. Co.	Slag from bottom of Vat next to Copper. W. Pass Flux.
Silica	50.60	65.76	37.20
Ferrous oxide	—	—	24.12
Ferric oxide	4.34	5.75	.00
Alumin. oxide	18.86	16.06	18.81
Lime	5.60	3.86	6.88
Magnesia	Tr	.10	Tr
Manganous oxide		.46	12.65
Phosphorous			
Sulphur			
Iron (total)	3.03		28.77
Manganese	6.00		9.8
[illegible]ition Loss		7.52	

1259

1164

W.P.+ Steel-slag off weld
Nov 1933

SiO_2 — 29%
Al_2O_3 — 30%
CaO — 19%
MgO — 3.5%
Fe_2O — 2.6%
$Na_2B_4O_7$ — 4.4%

62# Kaolin
27# $CaCO_3$
11# $Na_2B_4O_7$
7# $MgCO_3$

1166

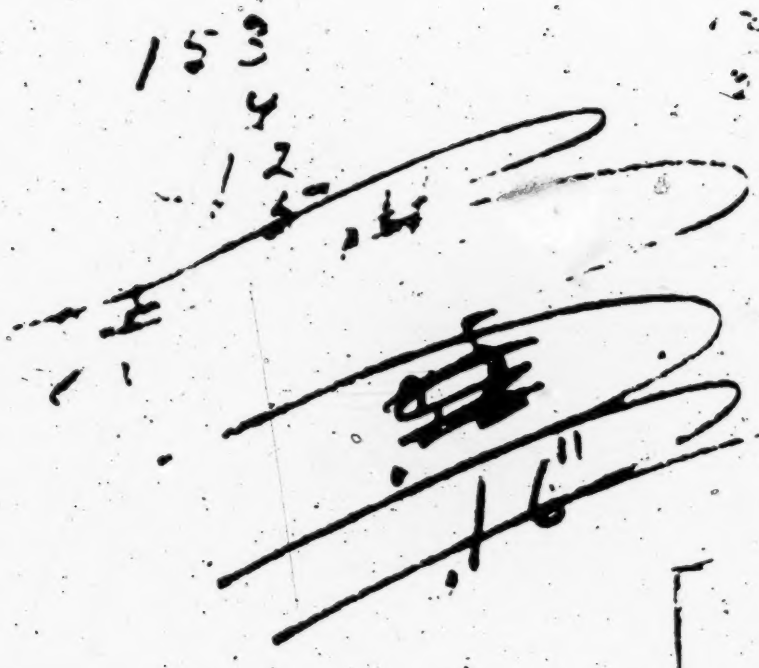
1167

PROF W = WEEKS
HEARST MINING BLD'G
BERKELEY

To open Book

lift end of lever slightly and shift to right.

In/min	Load (lbs)	Height (in)
5.4	800	
8.0	1200	
10.5	1600	
15.0	—	800
20	—	1065
25	—	1330
30	—	1600
37.5	—	200



R.P.M. to In/min.

Low Gears { High - $\frac{RPM}{153}$ = In/min.
Low -

High Gears { High - $\frac{RPM}{53.3}$ =
Low - $\frac{RPM}{153}$ =

May 3, 1932.

No Vee Tests, Automatic Weld, Western Pipe

Test	Rod	Flux	Volts	Amps	Travel In/min.	Plate	Quality
1	1/4" Nat'l	Marchant	30	700	9.5	.25" No V	10 holes/in.
2	"	"	20	700	9.5	"	3 "
3	"	"	20	500	9.5	"	Excellent
4	"	"	20	500	5.5"	"	Hole in not on surface
5"	"	"	20	700	12		Thin line of holes.
6	"	"	20	700	13.5"		Fewer holes than # 5"
7	"	"	25"	700	13.5"		Larger holes + not in line.
8	"	"	30	700	13.5"		Many, many holes.
9	"	"	20	550	13.5"	7/16" V	Holes + no heat.
10	"	"	20	500	10.5"	7/16 V	slightly better than # 9.

1265

11470

1266

We are erecting Red Tile. to date

May 20, 1930.

	[illegible]	Vel	Rod	Volts	Amps	Time	Flues	Remarks
1	1/4	45	3/16	20	400	6"	3	Fine structure, 98% clear
2	1/4	45°	3/16	20	400	6"	3	Raw, not fused. Many holes.
3	1/4	45°	3/16	20	400	5 1/4	3	
4	1/4	None	3/16	25	425	5 1/4	3	2 Bars, No holes, slightly coarser
5	1/4	None	3/16	30	425	5 1/4	3	2 Bars, 1 hole, Coarse structure
6	1/4	None	3/16	30	425	5 1/4	3	2 Bars, no holes, Coarsest structure
7	3/8	45°	3/16	30	600	5 1/4	3	
8	3/8	45°	3/16	25	600	5 1/4	3	Smaller uniform holes.
9	3/8	45°	3/16	40	600	5 1/4	3	Very hard.
10	3/8	45°	3/16	20	600	5 1/4	3	Many holes
11	3/8	115°	3/16	25	600	5 1/4	3	" "

1171

No arc control
Rod Neg.

May 20, 1932

5

Test	Hole	Vac	Rod	Hole to	Cubic	Feet	Flow	Flow Limit	Wet Mano	Remarks (over)
12	24	35	3/16	20+	700	5.2	3			2 holes / inch of intake tiny holes per inch.
13	24	35	3/16	20	700	4.75	3			Higher head than 12, 4 holes/inch on top.

1

1172

1267

1173

Feet	Plate No V V	Amps	m/m.
2	22	475	10.2 OK
3	22	975	10.2 OK
4	22640	650 to 650	10.2 OK
	5/16 Plate 35° V		
5	22	550	10.2
	Single fish line of holes		
6	22-25 More holes than #5	450	10.2
	5/16" Plate 35° V.		
7	Unable to make contact behave		10.2
	5/16" Plate 35° V		
8	19.24	650 Holes	10.2
9	20-22	500 Holes	7 3/4"
	5/16" Plate No. V.		
10			
	20	500	7 3/4"

Broken crack @ 45000. Pretty good metal. Fine structure.

1268

T-2: 4, 5, 6 examined.
Note that coarseness of weld metal structure increases with increased stage.

1175

12. Sought & he amidy cited & compare with 19.

1270

... analysis of samples 12, 14
... Aug 20 - 21, 1932.

	12	14
Rod	–	+
...	...	20
...	7 ...	7 ...
...	5.5	5.5
	.4	.08
	.017	.017
	...	.030
	.021	.016
Mn	.35	.40

Samples # 294 & 295

	294	294
Mn	.32	.21
S	.17	.37
C	.11	.08

1272

No arc control. Two arcs
Wires neg. Metal wire.

Test	Plate	Vee	size wire		Volts		Amps		Rod Polarity	Distance arcs, inches	Flux	Travel in/min.
			1	2	1	2	1	2				
14	1/2	45	1/8	3/16	24	22	300	400	-	2.3	3	6.5
15	1/2	45	1/8	3/16	24	22	300	400	-	1.75	3	4.0
16	1/2	45	1/8	3/16	24	22	300	400	-	4.0	3	4.0
17	1/2	45	3/16	[illegible]	20	[illegible]	600	[illegible]	-	[illegible]	3	6.0
18	3/8	45	3/16	3/16	20	20	[illegible]	500	-	10.4	3	5.8
19	3/8	45	3/16	x	20	x	700	x	+	[illegible]	3	5.5
20	3/8	45	3/16	x	20	x	900	x	+	[illegible]	3	7.7
30	1/2	45	3/16	3/16	20	20	500	500	-	.6	3	5 1/4
[illegible]												

11272

9

Remarks on reverse

14.

15.

16

17 ~~Short Rows.~~

18

19 } Duplicates of
20 } 12, 13 except position rod.

May 23, 1932

" " "

RPM	Inches.	RPM / 153 = in/min.
5-23	3.5	
1070	7.0	

Remarks

14. Looks like [illegible]. Too high, [illegible] on top, not wide enough. [illegible] cross cracks in 3 ft. length. Not melted into parents metal at all. Looks [illegible] between wires only.

15. Arc in flux only

16. " " " "

17. [illegible]. V not filled.

18. Slag in holes between arcs.

19. } Duplicate of 12, 13 accept root is
20. } position.

Sample of 19 to be analyzed to compare with 12. 98% clear.

20. Did not fill Vee, Holes on top.

30. Seams are controlled badly

1179

Mar 23, 1932

41

Bead to Right. Dust feel. Line holes
Sanitized

1274

Arc Control.

Plate	Volts	Wire				To surface
	45	3/16	30	400		1
	45	3/16		425	+ 3	5 1/4
	45	3/16	30	425	+ 3	5 1/4
24 1/4	45	3/16	35	425	+ 3	5 1/4
3/8	45	3/16	20	600	+ 3	5 1/4 10
3/8	45	3/16	25	600	+ 3	5 1/4 11
3/8	45	3/16	30	600	+ 3	5 1/4 7
3/8	45	3/16	30	600	+ 3	5 1/4 8
3/8	45	3/16	30	600	+ 3	5 1/4 9
3/8	45	3/16	30	600	+ 3	5 1/4

Penetration good on 21, 23, 23, 24

21. Holes only near top. Very fine structure. No holes in bottom.

22. No holes in top. Structure coarser than 21. 2 holes/inch from bottom to within .020" of top, holes .020" diameter. Beautiful weld on top, pretty flat bead.

23. A few interior holes.

25A. With pores. 3 bars in succession gave no holes. Bad on length.

27 Nice flat bead

1276

	Start volts	Start amps	R	Transmit volts	Transmit amps	R	
#18	80	350	.228	79	290	.272	
19	84	224	.375				
20	67	370	.180	66	400	.165	
22	76	240	.315	67	232	.289	@ 1" depth
23	73	192	.38	76	200	.380	"

May 25, 1982

Perfect penetration. Lv

Some on top, Small inclusions
on bottom
on bottom only

Small, bottom
inclusions only

in Bottom Very Small, Non on Top

Weld was all made very no mistake.

17 A.C. welding
Moore contr. - Watkins

Test	Plate	Volts	Amps	Travel Speed	Heat Input
31	3/8	45-51	320	5.2	2
32	1/4	45-51	200	6.0	3
33	1/4	45-51	200	10.0	6
34A	1/4	45-51	320	10.0	6
B	1/4	45-51	320	10.0	3
C	1/4	45-51	320	10.0	2
35A	1/4	45-51	400	10	3
B	1/4	45-51	400	10	2
C	1/4	45-51	400	10	3
36	1/4	45-51	400	10	6

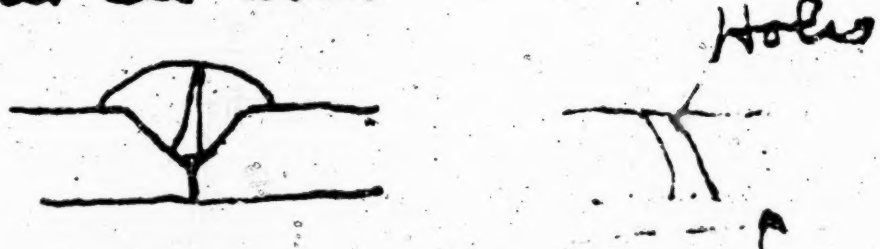
1277

Metal analyses.

1278

	Harbor Welding Electric Co.	Los Angeles Plate S.F. Plate	U.S. Wire Heat #5	Read-Avery Wire, Heat #6	Read-Avery new carbon wire	Weld Metal Tests Jones Flux #1	Weld Metal Test + Mag 3, 1932. Jones Flux #1	W. P. + S.C. Weld-metal tests	W. P. + S.C.	L.A. Weld Metal 4 Pl. W.P.S. Flux.	#53 Mich. Steel #1, Nickel wire.	Stobie, His weld metal, His flux, ½" plate	Stobie, His flux and weld metal, single pass.	J.K.R. weld + Rod + Flux 3	J.K.R. weld + Rod + Flux 3	Weld 261	Weld 274
C	.17	.16 .14	.15	.25	.05	.09	.07	.09	.11	.10	.08	.03	.07	.09	.08	.06	.10
P	.015	.024 .027				.019	.021	.025		.011	.03	—	—	.017	.017	.013	.021
S	.023	.024 .030				.074	.079	.031		.026	.024	—	.033	.025	.030	.028	.031
Mn	.72	.54 .63	.55	.13	.13	.25	.27	.41		.36	.29	.13	.21	.35	.40	.14	.22
Si	.07	.01 .035	.016	.01	.01	.38	.41	.17	.21	.05	.65	.04	.05	.021	.016	.46	.23

31. Holes all alike



Vee bottom not melted
Very bright metal.
Grooved.

32. Holes smaller but more numerous. ~~Flux is coated 3 slag with 21% CaO added.~~ Not quite Finer structure.
Bright. Perfect penetration.

33. Flux is coated 3 slag with 21% CaO added. Paper under 12" length. Paper made no diff. Almost no holes on top.

34 A Part flux 3, 32 v 640 amp.
B " flux 3a, 32 v 640 "
C " " 3a, 40 v 600 " - Looks best

32 A " " 3, 40, 600 "
B " " 3a, 40, 600 "
C " " 3a, 46, 545 "

These tests show many more and longer holes than tests 31-35. Indicate that flux should be low melting, low sp. gr. and low viscosity.

CO came up through pure NaCl & bumped. Pieces of unfused rod in melted NaCl were very bright & clean.

AC. Welding
No arc control.
Natl Rod

May 28, 1932

5

Test	Plate	Vee	Rod	Volts	Amps.	Travel	Flux	Holes/in inside	Top water per side	Dia. Rods	
36	1/4	45°	3/16	20	700	6	4	8	.2	.05	Penetration good but too much metal and too much heat. Fine structure. 3 in 1 plate. Slag clean next to weld. Cox comb.
37	1/4	45°	3/16	30	600	6	4	8	.2	.080	
38	1/4	45°	3/16	45	550	6	4	10	.1	.080	
39	1/4	45°	3/16	30	700	4"	4	5	0	.100	Voltage varied badly due to thin layer flux. Same setting as DC except speed and accidental variation in voltage. Cox Comb
40	1/4	45°	"	"	"	6	4	2	.1	.100	
41	1/4	45°	"	"	"	8	4	8	.2	.100	
42	1/4	45°	"	"	"	11	4	6	.5	.040	
43	1/4	45°	3/16	25	700	4	NaCl 30% #4-70%	6	0	.050	NaCl 30%, #4-70% Small holes on bottom as it from copper. Cox Comb. 1 time not fire dipped with NaCl.
44	1/4	"	"	20	"	6	"	6	0	.093	
45	1/4	"	"	"	"	8	"	6	0		
46	1/4	"	"	"	"	10.5	"	3	0	.045	

1186

1281

May 28, 1932.

26

1282

AC Welding.
No arc Control. Track - every $\frac{5}{32}$" weld.

Test	Plate	Rod	Volts	Amps	Travel	Flux	Holes/in in side	Holes/in top	Dia. Holes
47	¼	45 5/32	30	600	6	*			
48	¼	" "	30	600	6	4			
[illegible]	1/2	—	3/16	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]
[illegible]	"	—	"	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]
[illegible]	"	—	"	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]
[illegible]	"	—	"	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	3/16	30	[illegible]	1	[illegible]	.2	.050
[illegible]	[illegible]	[illegible]	5/32	[illegible]	8	1	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	3/16	30	640	8	1	[illegible]	[illegible]

* 30% NaCl 70% #4, not fused.

May 24, 1932

Burned through ½" plate!! Almost gas when flux. No weld at all. Fine structure.

5 welds. Two beads on plate on the other.

CO came up through
both flues & burned.

23

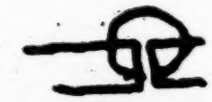
1284

A.C. welding. No arc control

May 30, 1938

1189

Test	Plate	Vee	Rod	Volts.	Amps.	Travel	Flux	Hobart Test	Hole in bottom	Dia. Hole	Shrinkage	
54	1/2"	1" 90°	3/16	22	700	9	1	0			.001	1/4 Penetration.
55	1/2"	1" 90°	3/16	28	640	9	1	0	.2	-	.030	1/2 Penetration.
56	1/2"	-	3/16	20-30	700	9	8	0	-			Flux too impossible.
57	1/2	-	"	25	675	9	7	0	0		.001	On flat plate, no Vee.
58	1/2	-	"	30	630	9	7	0	0		-	
59	1/2	-	"	35	600	9	7	0	0		-	
60	1/2"	1" 0"	3/16	22	600	4	7	0	0		.030	Necessitates 4" depth
61	"	"	"	25	"	5	7	0	.5		.030	Flux at 4" min. slag
62	"	"	"	"	"	6	7	0	0		.030	deposit 3" high.
60	"	"	"	"	600	4	7	0	0		.030	at 6" min. slag deposit at 1" high.

60.  Far too much metal on top. Penetration ¼"

61. Penetration ⅛". Too much metal on top

62. Penetration ⅛". Too much metal on top

63. Tendency to arc to flow copper.

64. No arc to copper. Tendency to blow flux off arc.

65-66. Flux 1 penetrated 1/4" at 11" min. whole flux 7 had 90% penetration @ 8" min.

65 Not quite fill Vee. Have flat weld. Holes.

66 Vee ½ full.

67. Vee full. Penetra. 3/8"

68. Vee slightly concave, edges caught. Penetra 3/8", edges

69. Vee more concave than 68. Penetra. 3/8"

70. Vee. nice + full. Penetra. 3/8"

AC Welding.
Vee arc Control.

May 20, 1932

Test	Plate	Vee	Feed	Volts	Amps.	Travel	Flow	Hoffman Tip	Hoffman Bottom	Diam. Holes	Structure	
63	1/4	45°	3/16	30	600	11	7	.1	.5	.030	.005	To compare with 42
64	1/4	45°	3/16	30	600	11	9	6	Holes clear through			" " 42
65	1/2	45	3/16	30	640	8	7	0	6	.030	.030	7 on comparison.
66	1/2	45°	3/16	35	590	11	1	.1	4.	.030	.010	Had to raise travel & kick off often. Voltage raised itself.
67	1/2	45°	3/16	30	640	6	7	0	.4	.040	.030	Vee full.
68	1/2	45°	"	30		6.54	7	0	.4	.050	.030	" - Vee full, flat.
69	1/2	45°	"	30		7.2	7	0	.4	.050	.020	" - " 90° full, flat.
70	1/2	45°	"	30		5.23	7	0	.2	.030	.030	Vee no molten.

Hoffman Tip Diam. Holes

27

1192

1287

June 3, 1932

28

1288

AC welding.
No arc control.

Test	Plate	Vcc	Rod	Volts	Amps	Travel	Passes	Accepted Top	Accepted Bottom	Dia. Holes	Structure		
71	1/4	1	3/16 Mat	20 to 50	600	6 1/2	11	1	-	.100			7 lines is end. Transverse cracks.
72	1/4	45	3/16 Mat.	23	650	7.5	7	0	1	.040	.025		
73	1/4	45	3/16 Van	23	650	7.5	7	0	.3	.030	.025		
74	1/4	45	3/16 Van coated	25	650	7.8	7	2	5	.060	.025		Thin wire & holes.
75	3/8	45	3/16 Van.	25	650	7.5	7	.1	0	-	.030		Very good bead not quite filling Vee.
76	"	"	"	25	650	6.0	7	.0	0	-	.070		
77	"	-	"	35	600	6.0	7	1.0	0	.030	.030		Holes in top only.
78	"	-	"	35	600	7.8	7	0	6	.020	.030		

71. holes are $\frac{1}{8}$" and deep. Metal cleaned flux and deposited on plate.

72. Excellent penetration, no bottom flux.

73. Voltage seemed lower than 72, 74. Welded nicely. Excellent penetration. No bottom flux.

74. Excellent penetration. No bottom flux.

75
-

76

77

78. Small interior holes starting at bottom where metal ran through.

29

June 6, 1932

30

Test	Plate	Vee	Rod	Volts	Amps	Time	Flux	Hockey Top	Hockey Bottom	Dia. Layers	Structure		
79	1/4	45°	3/16 Nat	23	700	11.5	7A	0				Too much penetra. Not enough metal & Lift Vee	
80	"	"	"	23	480	11.5	7A	0					
81	"	"	"	30	480	11.5	7A	3					
82	1/4	5°	3/16 Nat	22	440	11.5	7A	0	.5			82.	
83	1/4	5°.040	3/16 Nat	25	500	11.5	7A	0					
84	1/4	5°.040	3/16 Nat	20-30	500	11.5	7A	.1					
85	1/4	5°.00	3/16 Nat	21	530	11.5	7A	0	0				
86	1/4	"	"			11.5	WPS	0	4				
87	1/2	0°1/16"	3/16 Nat	22	520	6.0	10	0	.5	.150	.030		
88	1/2	"	3/16 Nat	35	900±	6.0	10	0	.3	.090	.030		
89	1/2	"	"	26	800±	6.0	10	0	0	—	.030		

Rod factor 1.3
Flatter than 85°
Penetra 3/8". Weak.
- Could get fusion faster enough. Penetra 3/8"
Penetration OK.

82. The Vee as due to clear marks
only ⊻ otherwise pivot tight.
Width at bot of groove 1/8".
Penetration to within 1/16".

31

June 5 1932

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Holes Top	Holes Bottom	Dia Holes	Structure	Remarks.
90	1-1/2+2-1/2	0°	1/4 Mat.	30	900	6"	10	0	0		Fine	Shot on mat plenty amps
91	2"	0°	1/4 Mat	60	—	6"	10					#4 mat app. 1000 amp;
92		0°	1/4 Mat	25	—	11"	10				Fine	
93	1/2"	45°	1/4	24	800	10"	10					153.
94	1/2"	45°	mat	24	800	11.7						1800
95	1/2"	45°		24	800	8.5						1300 - 48
96	1/2"	45°	1/4	28	760	—	10					Travel 6.5" to 9.15
97	1/2"	45°	mat	28	760	9.15	12					1/4" mat tacked along 96+97
98	1/2"	see		27	740	7.8	10					1200
99	1/2"	block	1/4"	27	740	9.1	10					1400
100		page	mat	27	[illegible]	10.5"	10					1600

72 One hole observed thought it to be c sec. penetration nearly adequate

90 — Penetration complete

91 - metal poured thru

00 - Rear gating #(5)

93 } Rear welds made which did not fill
94 } groove. Thus cleaned off &
95 } second pass made

Section 1 made with 25 volts increasing speed from 1000 to 1800 in 100 increments.

Section 2 made at 1150 RPM increasing volts from 25 - 30 - 42

Pass # 3 made over a thin section of Sec 1
30 volts 7½"/min amps = 725

98-99-100 {

AC Welding

June 7 & 8, 1932
50 KW transformer.

34

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Hrdns. Top	Hrdns. Bottom	Hrdns. Dia	Shrinkage	Penetration %	
101	1/2	I	1/4 Nat	30	1450	12.8	14	0	0	0	.030		
102	1/2	Over	1/4 Nat	45	1520	11.2	10	0	0		—	200	All in one plate.
103	"	"	1/4 "	28	960	15.0	10	0	0		.010	100	Short in reactor changed amount. Only speed changed.
104	"	"	"	"	"	18.	10	0	0		.010	99	
105	"	"	"	"	"	22.3	10	0	0		.004	75	Reactor on tap 9.
106	"	"	"	28	960	30	10	0	3		.001	60	
107	1/2	"	"	28 1/2	1050	29.5	10	0					Reduced 4'6". Reactor on tap 5.
108	1/2	90° V	1/4 Nat	23	1230	29.5	10						Reactor on tap 7
109	"	"	"	"	1070	29.5	10						" " " 8
110	1/2	"	"	30 3/5	1125 1120	29.5	10						

102 Vee planed 35° to ½" depth with ¼" shoulder

107. Rod used 4'6" for 4'0" weld Ratio 1.13. Nearly perfect filling and penetration.

108. Rod used 80". Length weld

110 - Same Vee as in 102.

1201

1296 A.C. Welding

June 9, 1932
50 KW Transf.

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Under Bead	Under Cut	36
111	1"	H	5/16"	20/40	1760	10	10			
112	1"	"	1/4	31	1540	8.5	10			

Too slow. Rumbled all along.

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Holes Top	Holes Bottom	Structure	Rate	Ratio Rod/Weld	Cracks	Type "AC"
113	1"	Y	1/4 Nat	0 to 45	1560	17.3	10	8			1		O.K.	
114	1"	"	1/4 Nat	26 to 33	1200	10.3	"				1.25	1.30	- 1/8	
115	1"	"	"	45 to 30	1420	6.5	"						OK	
116	1"	I	"	20	1360	10.3	16						OK	Tube and Sole
117	1"	"	"	20	1360	15.0	16						OK	
118	1"	"	"	20	1360	29.5	16						OK	
119	1/2	35° 1/4	"	28	760	10.3	16	0	0	.030			- 3/32	To Bun
120	1/2	35° 1/4	"	28	760	10.3	17	0	0	.030			- 3/32	
121	1/2	45° 1/4	"	25	910	10.3	10 8	0	0	.020			OK	To Noz sett
122	1/2	"	"	26	910	10.3	16	0	0	.020			OK	
123	1/2	"	"	30	900	10.3	17	0	0	.020			OK	
124	1/2	NO	114	24	900	10.3	17	0					- 1/8	To ch vee
125	1/2	NJ	3/16	30	900	10.3	17	0						

37

1202

1297

1298 AC welding.

1203

January 12, 1932
50 KW

38

Test	Plate	Vee	Rod	Volts	Amps	Flux	Travel	Hertz	Shrinkage	Penetration	Rod Consumed Lt./min	Rod/weld ratio	
126	1"	V	4th	22	960	17	7.0	0	.030		3.0	5.0	
127	1"	Y	4th	30	1450	17	29.5	.05		3/16	4.0	1.75	1st pass 3'-1" wire
1278	1"	"	"	25	880	17	5.0	or-		?	2.76	4.0	2nd pass 9'0" wire
128	1"	No	"	25/30	1760	17	10.7	0		Full			alligator weld.
129	1"	No	"	30	1760	17	20			- 1/8"			
130	1"	"	"	?	"	17	30			- 1/4"			alligator top.
131	1/2	No	"	25	960	18	10.3	-		- 1/32			To compare 124

116, 117, 118 } Metal sound down on top & tube. Cold shut at bottom.

119, 120 } To repeat no 99

121, 122, 123 } To check fluxes. No change in settings.

124, 125 } To check penetration.

127 pen. — 1/8" + 15/16" wide at top.
height above plate 3/16" 3/16" wide

131 just penetrated — 5/8" wide at top
5/16" above plate 1/4" wide.

12C Solid weld on 1 plate. Fine as 2nd pass. Voltage 15-20 in last foot of weld, Too short for flat weld. Heat Is 25.

127 Vee 95° ½" Reinf.

127B

128

131 Stands higher than 124.

132. Stands up like 131.

38 Stands up. Alligator. No use. Light penetration.

1302

AC welding.

Test	Plate	Vee	Rod	Volts	Amps	Flux	Speed	Hrs	Structure	Penetration		Remarks 50 KW +24
132	¼"	No	¼ Nat	25	910	20	10.3	0		-¼		To conform 124, 131.
133	½"	"	"	"	950	19	10.3	0				" " "
134	"	"	"	"	"	19D	10.3	0				" " "
135	"	"	"	"	"	19W	10.3	0		-¼		" " "
136	"	"	"	"	900	15	10.3					" " "
137	"	"	"	"	900	7	10.3					" " "
138	"	"	"	"	900	21	10.3					" " "
139	"	"	"	22	900	None	10.3			OK.		" " "
140	"	"	"	"	"	10	10.3					" " "

1207

A.C. Weld.
50 KW Trans.

June 16

43

Test	Plate	Vee	Rod	Volts	Amps	Flow	Travel Speed	Rod Consm. Length	Weld Length	Rod/Weld ratio	Heat In/Min.
141	¼	NO	¼	25	450	22	9.4	24"	9.5"	2.52	
142	"	No	"	"	"	"	8.0	24"	14.0	1.71	
143	"	"	"	"	"	"	10.6	13.5"	10.5	1.28	
144	"	"	"	"	"	"	15	12	13	.93	
145	"	"	"	"	"	"	20	6"	12	.5	
146	"	"	"	25	700	"	5.4	24"	5.9	4.1	
147	"	"	"	30	"	"	8.0	24	10"	2.4	
148	"	"	"	"	"	"	10.6	24	11.5	2.1	
149	"	"	"	"	"	"	15	17	11.2	1.5	
150	"	"	"	"	"	"	20	12	12.5	.96	22.4
151	"	"	"	"	"	"	25	7.5	8.0	.94	
152	"	"	"	"	"	"	30	7.0	10.2	.7	

1303

1208

145. Arc volts 0 to 110. Metal only now & then.

Test No	Penetration inches	Width weld at plate surface.	Area melt in plate
141	.122	.660	
142	.060	.540	
143	.123	.590	
144	.110	.500	
145	.050	.400	
146			
147	.285	.750	
148	.255	.730	
149	.295	.535	
150	.240	.530	
151	.193	.460	
152	.170	.475	

AC. Welding.

Test	Plate	Vee	Root	Volts	Amps	Travel	Flux	Rod Comb.	Length Weld Rod used		Penetration	
153	1/2	No	1/4	25	940	10.5	22	36"	13.5	2.67		
154	"	"	1/4	25/30	"	8.0	"	38"	10.0	3.8		Feed irregular.
155	"	"	"	25/30	"	15	"	31.5	16	2.0		
156	"	"	"	25	"	20	"	28.1	17	1.65		
157	"	"	"	"	"	25	"	29.3	10.5	1.1		
158	"	"	"	"	"	30	"	15.5	17	1.03		
159	1"	Y	"	25/30	1760	9.5	23	-	-	-		No mag. control.
160	1"	"	"	"	1600		"	-	-	-		With D.C. mag. control
161	1/2	No	1/4	22	1200	10.5"	22	31			150	Metal ran out. all along.
162	"	"	1/4	22	200	15"	22	15"			1..	
163	"	"	"	"	1200	9.1		11"			....	

454

1305

1210

159 } No noticeable effect of
160 } magnetic field noted.
Plate welded to copper throughout its length, thickness of 1/16" copper.

164. # 163 was running through and since 164 was a continuation it too went through.

Test	Penetr.	Width at top.	Area in plate.
153	.550	.610	
154	.500	.785	
~~155~~	.430	.520	
156	.345	.475	
157	.320	.470	
158	.310	.440	
161	.730	.735	
162	.600	.550?	
163	.630	.445	
164	.675	.500	

168 . Vee not

Test.	Penetra.	Width tob	Cream plate.
165	.320	.390	
166	.345	.460	
167	.350	.460	
168			
169	.360	.450	
170	.390	.470	
171	.500	.360	
172	.480	?.460 ?	
173	.600	.500 ?	
174	.700	.750	

47

1308

A.C. Welding.

June 15, 1932
50 KW. Trans.

48

Test	Plate	Vee	Rod	Volts	Amps.	Travel	Flux	Length rod used	Length weld	Rod/weld ratio	% penetration	
165	½	No	¼	25	1200	37.5	22	36	29.5			2000 R.P.M.
166	"	"	"	"	"	30	22	24	18.			1600 R.P.M.
167	"	"	"	"	"	34	"	12	6.5			1800 "
168	½	35	"	"	"	30	"	48	32			1600 for all tests.
169	½	No	"	"	1200	37.5	23	12	9.2			2000
170	"	"	"	"	"	30	"	18	13.0			1600
171	"	"	"	"	"	25	"	23.5	12.0			1330
172	"	"	"	"	"	20	"	24	11.0			1065
173	"	"	"	"	"	15	"	36	11.2		100	800
174	"	"	"	"	"	10.5	"	26	7.0		125	1600/525

Test	Penetra	Top width
176	.700	.660
176	.600	.550
177	.550	.535
178	.350	.470?
179	.290	.530
180	.290	.430
181	.120	.320
182	.150	.425
183	.165	.410
184	.260	.410
185	.145	.525
186	.125	.530

1310

AC welding.

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Rod Length	Weld Length / Rod Length ratio.
175	½	No	¼	22	960	8.0	29	36	8.7
176	"	"	"	"	"	10.5	"	36	11.3
177	"	"	"	"	"	15	"	35.5	14.5
178	"	"	"	"	"	20	"	20.5	11.
179	"	"	"	"	"	25	"	14.0	10.2
180	"	"	"	"	"	30	"	14.5	12.5
181	"	"	"	"	480	30	"	7.0	10
182	"	"	"	"	"	20	"	6.0	8.5
183	"	"	"	"	"	15	"	11.7	11.2
184	"	"	"	"	"	10.5	"	11.5	9.5
185	"	"	"	"	"	8.0	"	11.7	7.5
186	"	"	"	"	"	5.4	"	40.0	15.5

June 19, 1932

50

1215

2nd 1600
1st 800
1063
1330
1600

Volts, not down
Metal ran out
all three.

1600
1063
[illegible]

Test	Penetration	Top width	Guard plate.
188	.280	.720	
189	.265	.670	
190	.275	.600	
191	.255	.550	
192	.210	.480	
193	.240	.425	
194	.195	.470	
195	.340	.580	
196	.325	.475	
197	.185	.425	
198	.160	.440	

1312

AC Welding.

June 12, 19[redacted]

524

1217

Test	Plate	Vee	Rod	Volts	Cmds	Travel	Flux	Rod length	weld length	Rod weld ratio	Rod/mm					
187	[redacted]	[redacted]	4	25	480	6A	23	82	31.5	2.6						Not fused in.
188	½	No	"	-	700	5.4	23	-	-	-						Plate red at edge.
189	"	"	"	-	"	8.0	23	24	8.5	2.54						
190	"	"	"	-	"	10.3	"	24	12.5	1.97						
191	"	"	"	"	"	15	"	-	-	-						
192	"	"	"	"	"	20	"	-	-	-						
193	"	"	"	"	"	25	"	-	-	-						
194	"	"	"	"	"	30	"	-	-	-						2 holes in bot.
195	"	"	3/16	"	"	15	"	-	-	-						5'9" rod in 1M 50 sec
196	"	"	"	"	"	20	"	-	-	-						
197	"	"	"	"	"	25	"	-	-	-	364					
198	"	"	"	"	"	30	"	-	-	-						

AC welding.

June 19, 1932
50 KW. Transf.

Plate	Vee	Rod	Volts	Amps	Travel	Flux	Rod Length	Weld Length	Rod/weld ratio	Rod In/min.			
199	1/2"	3/16	20	700	5.4	2	—	—	—	44			Rod 15'2" in 4'5 cm
200	"	"	"	"	8.0	"	—	—	—				
201	"	"	"	"	10.5	"	—	—	—				
202	"	"	"	460	5.4	"				24.5			8'6.5"
203	"	"	"	"	8.0	"							
204	"	"	"	"	10.5	"	—	—	—				
205	"	"	"	"	15.0	"							
206	"	"	"	"	20.	"							
207	"	"	"	"	30.	"							

1313

1218

53

	Tenebra	Tmb width	Area
1		.880	
200	.355	.780	
201	.370	.570	
202	.206	.700	
203	.14	.620	
204	.68	.585	
205	.185	.475	
206	.22	.460	
207	.135	.360	

AC Welding.

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flame	Rod Extension					
208	½"	No	3/16	25	1020	30	23	1					
209	"	"	"	"	"	25	"	1					
210	"	"	"	"	"	20	"	—					
211	"	"	"	"	"	15	"	—					
212	"	"	5/32	60	860	37½	"						
213	"	"	"	"	"	30	"						
214	"	"	"	30	640	37½	"						
215	"	"	"	25-35	"	30	"						
216	"	"	"	30	"	25	"						
217	"	"	"	25	400	18.5	"						
218	"	"	"	"	"	9.0	"						

1315

1220

212 } Set per 1020 amp. 25 volts
213 } but wire could not feed fast.

Test.	Penetra	Width	Area.
208	.400	.400	
209	.490	.495	
210	.510	.600	
211	.550	.650	
212	.550	.450	
213	.550	.450	

A.C. Welding.

June 21, 1932
50 Kva Transf.

Test	Plate	Vee	Rod	Volts	Amps	Transf	Flux							
219	¼	No	⅛	25	400	5.4	23							
220	"	"	"	"	"	8.0	"							
221	"	"	"	"	"	10.6	"							
222	"	"	"	"	"	15	"							
223	"	"	"	"	"	20	"							
224	"	"	"	"	"	30	"							
225	"	"	"	"	640	30	"	—	—	—	—	—	—	Rotten Control.
226	"	"	"	"	"	20	"							
227	"	"	"	"	"	15	"							
225	"	"	"	"	640	5.4	23	—	Repeated.					

1317

1222

Test	Penetration	Width	Area
219	.160	.840	
220	.285	.515	
221	.240	.500	
222	.210	.550	
223	.190	.315	
224	.135	.350	
225	—	—	
226	.400	.995	
227	.360	.912	
228	.350	.592	
229	.250	.695	
230	.240	.555	
225A	.365	.870	
226A	.250	.695	
227A	.550	.525	

AC. Welding

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Magnetic Deflection	Penetration
226	½	No	5/16	25	640	5.4	23		
227	"	"	"	"	"	8.0	"		
228	"	"	"	"	"	10.6	"		
229	"	"	"	"	"	15	"		
230	"	"	"	"	"	20	"		

June 28, 1932

240	1"	Y	¼	32½	1520	12.5	31			No	110%
241	1"	Y	"	"	"	"	"			yes	110%
242	1"	over	"	30	1350	11.0	32			No	100
243	1"	"	"	"	"	"	30			No	
244	1"	"	"	"	"	"	30			No	
245	1"	Y	"	30	1200	4.3	31	-	-	No	- 100%
246	1"	"	"	30	"	5.0	31	-	- -	No	- -

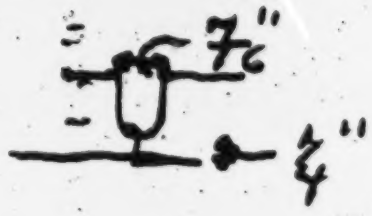
1319

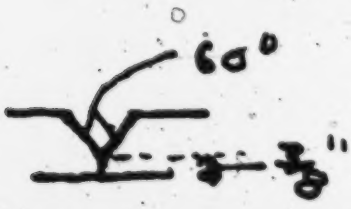
59

1224

1225

240-1

242-4 

245~ 

Field made weld narrower.
Without field
penetration was less at 4" than at 8",
too much metal.

1320

60

AC Welding

January, 1932

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Penetration	
247	1"	60°	¼	30	1200	6.0	31		
248	1"	"	¼	25	"	"	31		Rotten Control
261	1"	"	¼	20 40	1200	6.0	30	100%	Clock control
262	1"	"	¼	37½	1200	5"	0 30	100%	Clock control.
263	1"	"	¼				30		

D.C. Welding

264	¼"	45°	3/16	30	500	6	34	Holes on top 1/1" with arc control.
265	"	"	"	37½	600	6	34	
266	"	"	"	"	600	6	34	
267	¼	45	"	20	400	6	34	
268	"	"	"	20	400	6	19	

61

1321

1226

247

undercut on exit.

248. Ditto except no undercut

261.

3/16" Contour not good,

262. Same Vee as 261. Contour N.G.
7 sec. { 1 sec. @ 15 volts.
6 sec @ 37.5 volts

263.

shoulder

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	
270	3/8	35°	1/4	30	700	11	33	
271	"	"	"	35	750	11	"	
272	3/8	"	"	25	750	11	"	
273	"	"	"	35	800	11	"	
274	3/8	"	"	35	800	15	"	
275	"	"	"	25	750	15	"	
276	3/8	0° 1/16	"	25	700	15	"	
277	"	0° 1/16	"	30	700	15	"	
278	3/8	0° 1/16	"	20	800	15	"	
279	"	0° 1/16	"	35	850	15	"	
280	3/8	35°	"	25	950	15	33	
281	"	"	"	"	"	"	34	

Plenty holes as if from lack of penetration.

Some plug holes.
Fewer plug holes.

Fair penetra: in groove, few holes
- - - - - - - - - - - - - Dumpty + load.

1229

280. Cut few holes, but far fewer than in 274 etc. Holes due to lack of penetration due to metal running ahead in groove.

1324

64

AC welding.

July 21,

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Holes/in Bottom
282	3/8	0	1/4	25	910	16.5	33A	
283	"	0	1/4	30	990	18.5	33A	
284	"	0	"	30	990	18.5	32	
285	"	36°	"	27	910	18.5	33A	
286	"	"	"	27	910	20	33A	
287	"	"	"	30	910	20	35	10
288	"	"	"	27	950	16	35	.2
289	"	"	"	26	835	15	35	
290	"	"	"	26	835	13	35	0
291	"	"	"	27	835	13	36EF	
292	"	"	"	28	835	13	35	
293	"	"	"	28	835	13	35	
294	"	"	"	30	835	14.5	37	

No holes
.5" hole .020" v .030"

July 23, 1932
Moisture in flux??

1 specimen

65-1

1325

1230

AC Welding.

July 30, 1921

Test	Plate	Vee	Rod	Volts	Amps	Travel	Time	
295	3/4	No	1/4	28	825	9.4	37	Two beads on top each other. Cracks.
296	3/8	35°	1/4	28	830	14.5	40	Holes clean through. Flow not yet dried.
297	"	"	"	"	830	14.5	40	No holes. Flow dried red hot.
298	"	"	"	"	"	14.5	39	99% Iron Oxide. Very few holes.
299	"	No	"	"	800	14.5	41	Practically no good.
300	"	35°	"	"	825	14.5	39	Perfect. Structure .001
301	3/4	No	"	"	825	9.4	39	Two beads atop each other. Compare 295.
302	3/4	No	"	"	825	9.4	40	Two beads atop each other. Compare 295 - 302.
303	3/8	35°	"	"	"	14.5	39	For tensile test. Black plate, no rust; not ground off on back.
304	"	"	"	"	"	"	40	
305	"	"	"	"	"	"	42	

Plenty Burn cracks.

Metal Analyses.

	Weld 294 Flux 39	Weld 295 Flux 37	Weld in Vee Flux 39	Two beads Flux 37	¼" coat 1204	¾" coat 1204 in phos.	¾" coat flux 39 in phos.		
	299	300	301	412	413	415	424	427	
C	.11	.08	.12	.09	.08	.15	.15	.08	.17
P					–	–	–		
S					.023	.024	.030		
Mn	.32	.21	.32	.24	–	–	–	.65	.33
Si	.17	.37	.14	.22	.24	.29	.24	.19	.35
B									

1327

Test Bar 64950

Cracked

1232

1237

[redacted] Tacked (continuous) with Flat weld - as much alloy in structure as possible. No holes on top.

316. Tacked (continuous) with Vanadium and 39 flange, 2 to 10 holes per inch on top.

317. Tacked (continuous) with Nail tube wire and 39 flange. Pretty fair. 4 holes in 18"

318. Tacked (continuous) with Nail tube automatic wire and no flange. 2 to 10 holes inch.

with higher current density greater penetration is secured i.e. arc at chill bar + metal is narrow on top.)
Weld turned out not as wide as we had expected. No holes - strong weld
Sample planed flush on top about two sixteenths
6 34 volts - 11 ½"/min gave not quite as good a weld as # 4. Decided to weld the pipe at 32 volts 11"/min
1st Pipe weld ran out as back up bar was not adjusted good.
2nd seam - many holes, apparently originating in slag pockets against chill bar.
No uniformity of penetration width (as much as ½" where there was a deep slag + occasionally insufficient penetration)

Aug 10th
46 Flux (regrind # 43 from pipe welds) at 28 volts 11.5"/min [redacted] gave as many holes as previously. Weld had same appearance -
3 When main [redacted] was opened there
4 sloped rise was about ½" below plate surface.

1333

1233

298. Oxide not removed from back.
300. Oxide removed from back. a few small holes.

297. 30% fine structure, 60% coarse.

303. Tensile - all six broke in plate.

304. Fused 6" plenty holes because are uncovered. 1 hole in or top in remainder.

305. No holes at all. Good looking weld but lots of cracks both transverse and longitudinal.

A. C. Welding.

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Helium/Argon	Holes/Bottom	Penetration	Structure
306	3/8	35	1/4	28	825	145	44				
307	"	"	"	"	"	"	43.8		4 inside		
308	"	"	"	"	"	"	43A	0	0	100.001	
309	"	"	"	30	"	13.5	43B	0	.05	120.020	
310	"	"	"	25	"	14.5	43C	0	2	100.020	
311	"	"	"	"	"	"	43A	0	0	100.001	
312	"	"	"	"	"	"	43D	0	0	100.001	Some. 020
313	"	"	"	"	"	"	39	0	0	100.001	
314	"	"	"	"	"	"	43C	0	0	100.001	

Note: Wire consumption 5 2 ft for 30 ft seam.

see the weld.
Black. Not ground on back.
" Ground on back.
" " " "
" " " "
" " " "
" " " "
" " " "

1234

1329

310 Thinner flux (so blue of arc could be seen) gave wider and smoother weld with more luster and slightly less penetration.

Pipe. Grind inside. Motor brush or tacks.

1st seam showed holes on top thus ••••• where tacks were. On second seam tacks were motor brushed and no holes showed.

A.C. Welding.

Aug. 5, 1932.

Test	Plate	Vee	Rod	Volts	Amps.	Time	Light Hrs.	Hole Min.	Sec.	Penetration	Structure
315	3/5	35	14	28	125	14.5		0		93%	Each plate was "all tacks." Each weld brushed and ground on back
316	"	"	"	"	"	"		3		93	
317	"	"	"	"	"	"		2		93	
318	"	"	"	"	"	"		3		93	
Pipe	"	"	"	"	"	"		Min.		Min.	
319	"	"	"	"	690	11.0		46			just as many holes in slag.
320	"	"	"	"	690	11		43			
321	"	"	"	"	690	"		47			no holes showing
322	"	"	"	"	690	"		45			

AC. Welding.

Test	Plate	Voc	Rod.	Volts	Amps	Travel	Flow	Hole Exp	Hole Hinde	Cracks	Shrinkage	Width		
323	3/8	35	1/4	28	525	14.5	43							
324	"	"	"	"	"	"	48							
325	"	"	"	"	"	"	W.P.S.							
326	"	"	"	"	"	11.0	49							
327	"	"	"	"	"	"	W.P.S.							
328	"	"	"	"	800	16.3	52	0	4	100	.005	1.0		
329	"	"	"	"	800	16.3	52	0	5	100	.020			
330	"	"	"	30	800	12.0	52							
331	"	"	"	32	800	12.0	52							
332	"	"	"	30	"	"	51	.5	5.0	100	.030	1.0		
333	"	"	"	32	"	"	51	0	2	100	.130	1.0		
334	"	"	"											

1239

1334

Not ground on [illegible]

1240

AC Welding

August 21, 1932

1335

73

Test	Plate	Vee	Rod	Volts	Amps	Travel	Time	Hobart Tab	Idem Time	Puncture	Structure	Width Depth	
334	3/8	35°	1/4	30	800	12	53	.1	2.0	100	.030		Hot ground Back
335	"	"	"	32	500	12	53	.1	2.0	100	.030		
336	"	"	"	"	"	12	"	0	0	100	080		Ground Back.
337	"	"	"	"	"	11.0	"	0	.05	100	"		
338	"	"	"	30	"	11.0	54	4-1/8"	—	100	.030		all holes went clear through.
339	"	"	"	"	"	"	40	0	1.0	95	.001 - 80% fine		
340	"	"	"	"	"	"	55	0	2.0	100	.001		
341	"	"	"	"	"	"	53	0	.1	100	.080		Ground Back
342	"	"	"	"	"	"	40	0	0	100	.020		
343	"	"	"	29	"	11	56	0	.1	100	.025	.4	Hot ground on Uncle
344	"	"	"	"	"	14.3	56	0	.1	90	.5	.8	
345	"	"	"	"	910	14.3	56	0	.2	100	.015	1.0	
346	"	"	"	"	910	12.5	56	0	.2	90	.020	.5	

40+ turns Manganese in groove (over)

336 } Nice wide flat weld, no imprint
337 } on back. 7/8" wide.

338. Slag 3 times as wide as 337.
Weld lousy with holes. Weld same
width as 337. No imprint on
Back is beautiful. Same as
above [illegible] looks like machine weld.

339. 2 match pieces. No Slag
at all. Calcined at bright red.
Quiet arc. 25 amps. Silicon at
spot 339-1 cracked it.

340. Beautiful flat wide weld. [illegible]
back. Surface quiet ground under.

342-a

[illegible]...strong weld,

1336

Test	Plate	Vee	Red	Volts	Amps	Transmd	Flmg	Hours hr	Hours minim	Puncture	Standard	Width Exp.	
347	278	36	4	24	1130	16.5	60	0	.2	105	.020	.8	Wash in track
348	"	"	"	"	"	21.1	"	0	.5	100	.005	.75	Not ground track
349	"	"	"	32.5	1080	16.2	"	0	1.0	100	.020	.9	Lots of sag
350	"	"	"	32.5	1080	21.1	"	.2	1.0	100	.020	.75	Blue arc bottom.
351	"	"	"	22	990	11.3	"	0	0	100	.010	.75	not ground.
352	"	"	"	"	990	15.2	"	0	0	100	.010	.60	
353	"	"	"	28	945	11.0	53	0		100	1.0	"	Not ground.
354	"	"	"	30	925	11.0	40N	1		100	1.0	"	-(over)
355	"	"	"	25	820	10.5	53	0		100	1.0	"	Not ground.
356	"	"	"	"	820	10.5	40N	.2		95	1.2	"	
357	"	"	"	"	820	"	53	0		90	1"		not ground.
358	"	"	"	"	"	"	Over	0		90	1"		

1337

1242

1243

349-50 Hot ground on back.

347-8 Some wash on back.
a good many bottom holes.
Both very strong welds.

349. Strong and lousey with holes.

351-2. ⟵ High bead. No wash.
No holes at all.

353. Perfect on back.
354 Heat-gun next copper.
Many big holes caused by sand.
356 - 1st penetration few holes
strong on hammering
353 pen. OK, many holes - brittle
354 - Strong on hammering.
355 - many small holes - no straight
coarser grain than 356
355 Metallic Al dusted in Vee and
on back of plate. 53 Flux

1338

08

Cumb, 1932

G. C. Williams

Test	Field	Acc	Chromosome	Width	Ht	Ground	Vols	Form	Stem	Flow	Hairs	Height	Resistance
359	36	35	44	15	9	10	12	5	7	0	8	10	0
360	"	"	"	"	"	"	"	"	"	0	6	10	0
361	"	"	"	"	"	"	"	"	"	0	10	10	0
362	"	"	"	"	"	"	"	"	"	0	12	10	0
363	"	"	"	"	"	"	"	"	"	3	12+	10	0
364	"	"	"	"	"	"	"	"	57	0	0	8	0
365	"	"	"	"	"	"	"	"	57A	0	0	8	0
366	"	"	"	"	23	3	10	10	12	57	0	4	10
367	"	"	"	"	23	3	10	10	..	57A	0	.3	10
368	"	"	"	"	28	9	10	12	40M	4		10	6
369	"	"	"	"	"	"	"	9	10	12	.2	4.	10
370	"	"	"	"	"	"	"	"	"	12	0	.1	10

79 | 6L

Chromosome width Ht Ground on Rock

" " " "

360. 53 flux with Cl in groove & 1/16" and on surface. Some fine structure with no holes in it. 30% of flux black —

361. 53 flux with Cl and 2% black — groove

362. 53 flux with Mg. crucible in groove & 1/16". Traces of fine structure, resh .020

368. Volts reduced to 22 at end to get penetration. Thin coating flux to cover arc. Zero tap holes at start and 10 holes/in at finish where arc covered and volts low. Very less thick flux. Many and invisible holes in slag. Weld has peanut effect of invisible slag.

369 Not too hard. Only one speck of slag holes.

370 Just little better than bare wire weld. Brittle as cast iron but only one small hole.

1340

A.C. Welding.

Sept 2, 1932

Test	Plate	Vee	Root	Volts	Amps	Travel	Flux	Holes Dia	Holes Width	Penetration	Slag Inclusion	Undercut	Width	
371	3/8	45°	1/4	30	920	12	57	0	6	95	.015	No	.95	
372	3/8	"	1/4	28	"	"	57A	0	6	100	.020	No	1.05	
373	5/16	"	"	30	"	"	57	0	.05	100	.015	yes	1.0	Holes only 1/32 deep.
374	5/16	"	"	30	"	"	57A	0	.05	100	.015	yes	1.0	
													Sept 3, 1932	
375	3/8	35	"	28/30	920	13/15	40M	0	0	110	.015	No	.80	(over)
376	"	"	"	28	920	12	40N	0	3	110	.020	No	.60	"
377	"	"	"	"	940	"	59	0	4	100	.020	No	.50	"
													Sept. 5	
378	5/16	"	"	27	940	12	60	0	3	100	.020	No	.90	No wash.
379	"	"	"	28	940	"	43F	0	2	100	.020	No	.95	No wash.
380	5/16	"	"	28	960	12	61					no	Sept. 9. 13/16" wide 5/8" int.	
381	"	"	"	"	"	16	"					no		
382	7/16	"	"	27	940	12	61					no	Last pt. with ferro mgn.	
383	"	"	"	"	"	"	61							

1341

81

1246

1247

375 Flux 40N deposited by 41° Bc.
Washed + dried fortnight.
Free SiO_2 is the harrowing and
penetrating rascal. Only a few
small holes in slag.

37C Flux 40NB is black due to
iron oxide from sintering pot.
Plenty holes in slag.

377. Weld is wider and straight.
Almost zero wash. Fine
structure is now gone.

378 } Interior holes are small
379 } and not long. Due to Fe_3O_4
on bottom.

38c ~~best~~
385 ~~at~~ Less Mgn quite high percentage
produced cracks

383 - a little more narrow than,
382 and strong without holes - some wash. good glass.

382 - no wash - not quite pen. a few holes - coarser grain than 383.

381 - heavy wash - few holes fine grain - strong

380 - no wash - good pen. (center section tight on bar)

382 when not quite pen, nearly free from holes, when it did pen (tho no wash) many holes.

6.2 Flame gives light blue color to slag

A. Wellington

Sept 9-10, 1932

Test	Plate	V	Rod	Volts	Amps	Time	Flux			Points	—	
384	5/16	38°	1/4	28	940	12"	62					wider than .385 heavy wash
385	"	"	"	"	940	16"	62					
386	"	"	"	"	"	12"	62					} + a little ferromag
387	"	"	"	"	"	12"	62					
388	1"	over	1/4	23	1180	4.9	60			95%		
389	1"	"	"	28	1160	4.9	60			98%		
390	5/16	"	"	30	920	12	60					Sept 16
391	5/16	35°	1/4	28	930	12"	63					} slag blue, thin + very brittle plate not ground on back
392	"	35°	1/4	28	930	16"	63					
394	"	"	"	"	"	12"	60					} plate ground on back
394	"	"	"	"	"	16"	60					
393	"	"	"	22		12"	60					

1250

388 V 35°. 3/16 shoulder.
Too low volts to be smooth on top.
Start was 25 volts and OK.

389 V 30° - 1/16" shoulder. Looks
like 30 volts would be perfect.

390 ⊐⊏ 1/8" gap. 1/16 shoulder. 35°

---

391 - 9/8" wide on top 3/8" wash

392 5/8" " " " 1/2" "

1345

85

Test	Depth of plate	V	Rod	Watts	Pumps	Travel	Plant	Period	Ground Back	
396	1/16	34	1/4	28	800	12"	60			Plate ground off both ends - specimen beam - bottom V.
397	1/16	34	1/4	28	800	16"	"			
398	"	"	"	"	680	12	"			ditto 396 + 397
399	"	"	"	"	"	16	"			
400	"	"	"	"	"	12	"			as above but fence was out
401	"	"	"	"	"	16	"			
402	"	"	"	"	810	12	"			60 ∫ + (∫c) + Beam ∴
403	"	"	"	"	810	16	"			
404	"	"	"	32/30	940	16	60		yes	
405	"	"	"	30 TO 35	1120	4.5	60		"	
406	1"	30	"	32	1500	5.5	60	150	"	1/8" shoulder
407	1"	35	"	32.5	1150	5.0	60	95	"	" " Beautiful flat top.
408	1"	35	"	"	"	5.5	"		"	" "

1346

D Heavy wash in all welds up to in including 401. Thought that Fe Mn in V caused it.

D Noticed no smell of H2 so mixed 6 oz to 7 ± lb #60 flux reactor back to that used in 396-397

(7# flux to 30" weld)

20/1 ratio

406. Melted ½" into coffin with no arc below. Coffin real hot.

$$\frac{7\frac{1}{2}}{11\frac{1}{2}} \quad \frac{120}{6} = 20$$

Sept. 20, 1932

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Tot. Holes	Tubular holes	Penetration	Ground Back	Looks	
409	1"	38°	1/4	32	1120	4.5"	60-1	0		100	yes	100	No shoulder
410	1"	"	"	32.5	1230	6.0	60.1	0		98	"	100	1/16" "
411	3/4	3/4"	1/4	32	1140	8.0	60-1	0		100	"	100	Vee to bottom. Perfect
412	"	1"	"	"	"	6.8	"	0		100	"	"	
413	"	"	"	"	"	"	"	0		100	"	"	with x3 CE in Vee
414	"	5/8	"	"	"	9	"	0		100	"	"	"
415	"	"	"	"	"	9	"	0		100	"	"	Not full enough. Flush.
416	1 1/2	3/4	"	"	1230	3.8	61	0		?			Two 3/4 plates
417	3/4	None	"	"	1140	9.0	65	-		100		0 %	Emulsion flow-steel
418	9/16	35	"	"	880	9.5	66	-.5		100		95%	
419	3/4	5/8"	"	"	1150	8.0	61-2	0		100		100	Same as Tipc.
420	1"	3/4	"	33	1230	6.8	61-2	0		95	yes	90	a little rough on top.
421	3/4	4"	"	33		9	8.0	61-2	0		98	yes	100 (over)

1254

409. Flux 60-1 means rosin gigged once by adding 6 oz. per 7 lb. La 7₂ after having been used. Too much width of Vee at top to fill.

416 Vee ⋁ ¾" × ¾", No shoulder

421 Vee ¼" wide at top + extending to bottom. Too narrow.

1349

89

AC Welding

1350

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Tack Inter.	Penetration	Ground Back	Looks etc.
422	3/4	1 1/2"	1/4	31	1140	9"	68	OK	110	yes	100 for part length
423	"	5/8	"	33	"	8"	70	0	190	"	Bad wash
424	"	"	"	"	"	"	70-1	0	100	"	Very slight wash. Looks 98% (over)
425	"	"	"	"	"	"	68-½	0			
426	"	"	"	"	"	"	68-1½	0		"	
427	"	"	"	"	"	"	"	0		"	with cast iron,
428	1"	.65"	"	33	1230	6"	68-1½	0	98	"	— Looks 100% Over Too Narrow Vee
429	1"	.65"	"	"	1230	5"	68-1½	0	"	"	
430	1"	.70	"	"		6	68-1½	0	95		Same 68 with 1% normal CaF_2 or 1½ oz per 10 lb.
431	1"	.70	5/16	"	"	6	68-1½	0	95		

90

1255

$MnSi_3$ blows is too [illegible]
was tap wash. [illegible]
CaF_2 per 7.5 lb. [illegible]
worked OK.

424 Analyze for C Mn Si.

425. Not enough CaF_2 in melt, so
6 g. per 15 lb. Still [illegible]

426. Added 18 g CaF_2 to [illegible]
and 10% CaF_2 in melt.

427. Same as 426 with more
cast iron. Analyze for C
Mn
Si

428. More metal than
necessary to fill [illegible].

62

1352

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Tot holes/sq in	Entrance holes/sq in	Penetration	Ground Back	Welds	
432	1¼	mm	5/16	33	1500	6	60%	0		120	Yes	0	
433	1¼	"	"	"	"	4	"	0		100	"	100	Excellent.
434	1¼	"	"	"	"	4	mm	0		100	"	95	Heavy fingers
435	1¼	"	"	"	"	4	"	0		-3/16	"		
436	1¼	"	3/8	35	1500	5	"	0		-	"	90	
437	1¼	"	"	35	1540	6	"	0			"	100	Nice flat bead
438	1¼	"	"	32	1630	6	"	0		99	"		Not as flat as 35 v.
439	1¼	"	"	32	1620	6.5	"	0					
440	1¼	"	"	32	1600	6	65%	0		99			
441	1	"	"	32	1600	8.5	65%	0		100			

432 3/4" st. sides 1/2" down then Vee to bottom.

433 Same Vee as 432. Wire feeds only by rigorous pinching.

434 Same Vee as 432. Flux 68 + 18 oz CaF_2 per 15 lb.

434½ Same Vee as 432. Flux 68 + 18 oz CaF_2 per 20 lb.

436 Vee 1/4" straight then Vee to bottom, 1 1/16 wide.

437 Vee same as 436. Flux 68 plus 2% CaF_2 in mix and 19 oz per 22 lb. mixed cold.

438 Vee same as 436. Flux same as 437 except Beach Sand in last part replaced down to only 9 ounces per 22 lb.

439. Same Vee as 436. Same flux as 437 1" deep then 63 on top.

440. Vee only 1/2" wide. Too narrow. Flux 68 + F melted glasses with no CaF_2 till cold.

9/3441. Vee 5/8". Same flux as 440.

1354

A.C. Welding.

Nov. 11, 1932

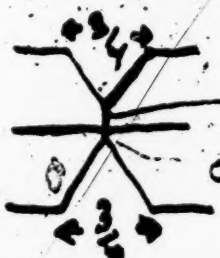
4th

1259

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Tons Weld	Penetration	Looks	
442	1¼	one	¼	35/32	960	8.5/7.0	68+F	0			Perfect weld.
443	¾	⅝	¼	32.5	1120	8.0	68+F		100	for test bars.	Proper speed 9"
444	¾	⅝	¼	32.5	1140	7.5	72	0	100		
445	"	"	"	"	1140	7.5	73				
446	2"	3/4"	3/8	35	1310	8.0	68+F		1st pass. Over		156. on meter =
	2"	3/4	"	31	1650	7.0	68+F		2d pass. "		10 t. on "
447	½	⅝	¼	33	1000	8.0	"	0	100	(over)	High Carbon
448	2"	one	¼	33	1345	7.5	68+F	0		Both passes.	
449	2"	"	¼	33	1345	7.0	68+F	0	99		
450	2"	"	3/8	33	1600	7.0	68+F	0	100	100	
451	2"	"	3/8	"	1600	7.0	"				Solid plate.

442. Continuous track.
1 pass C&F + backside,
1st pass rotated 8.5" @ 35 volts,
2d " 7" @ 33 volts.

446 Two 1" pieces thick-1-inch for 2".



1 st. pass. Ran through @ 32.5 V &
1390 amps at 35 V &
1310 amps. Ran runs out but not full at 8".
Preheat used 1 pass 7"
2d pass voltage too low.

444. Carbon .08 Mn .49 in weld.
Weld analysis ↗

447. High carbon. C=.32 Mn.49.
Weld analysis –

448

Vee 1" wide 5/8" deep
Reactor 15 T on 75 V.
Symmetrical Vee
~~1st pass rotated 8.5" 2d pass 7"~~

449. Same Vee as 448. 40° to vertical

450. Vee

30° to vertical.
Symmetrical Vee

95

Rod ratio 3 to 1

451. Same Vee as 450. Solid plate.

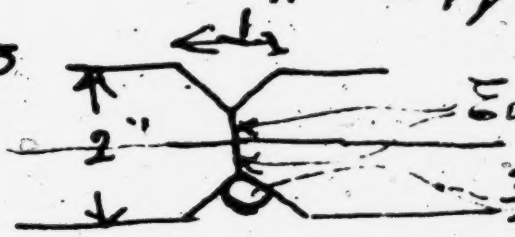
Test	Plate	Vee	Feed	Volts	Amps	Travel						
451	1¼"	over	3/16	34	1600	5"						
453	2"	over	3/16	33.5	1480	6"						
	2"	pass	"		1520	6"						
452	2"	over	3/16	33.5	1500	6						
	2"	"	"	"	"	7						
455	2"	"	3/16	33.5	1530	6	1st	pass				
	2"		"	33.5	1500	6	2d	"				
487	2"	"	3/16	33.5	1550	6	1st	"				
	2"		"	33.5	1500	6	2d	"				

Numbering on the 2d pass side

452

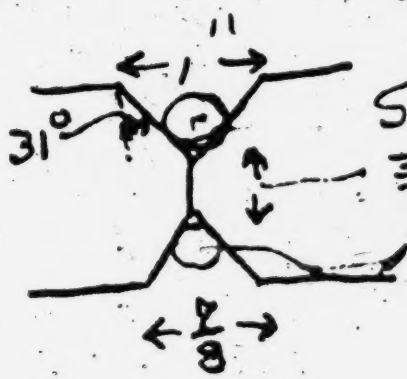
Nozzle tilted back 10°

453



454 Same as 452 except 7"/min on 2d pass.

455



456. Same Vee as 455 but no rods tacked in.

Test	Plate	Vee	Rod	Volts	Amps	Travel	Flux	Power	Rocker	
457	3/4	11/16 over	1/4	33	1100	7	68+F	100	100	Curvature build plate off copper too far.
458	3/4	11/16 -	1/4	33	1250	9	"	100	100	
459	"	5/8	1/4	33	1100	7	"	100	100	
460	"	5/8	1/4	33	1150	9	"	100	100	
461	"	5/8	1/4	33	1200	8	"	100	100	
462	"	5/8	1/4	33	1200	8	"	100	100	
463	"	1/2	1/4	33	1200	8	"			
464	"	1/2	1/4	33	1200	10	"			
465	"	1/2	1/4	33	1200	12	"			

457-8 Vee to bottom.
Copper groove .025" x 1"
457 - 20 T on reactor
458 - 20 T plus 40 T shunts on full reactor

459-60 Vee to bottom. Same Copper.
460 20 T + 25 T shunt.

461 Vee to bottom. Same Copper.
20 T + 30 T on reactor.

[fol. 1360] DEFENDANTS' EXHIBIT 98-A

The Linde Air Products Co., New York, N. Y.

December 1, 1942.

All District Sales Offices.
All Division Sales Offices.
All Division Process Service Managers.
All Division Accountants.
Messrs. C. T. Bogert.
F. C. Hasse.
D. S. Lloyd.
J. R. Lotz.
T. C. Manton, Jr.
L. E. Ogden.
F. A. Potts.

General Letter S-13

Subject: Unionmelt Welding Process
Unionmelt

GENTLEMEN:

There have recently been a few instances of customers ordering sizes, grades, or quantities of Unionmelt which they later found they could not use, and requesting permission to return all or part of the material. In the past when Unionmelt was packed in steel drums, the return of material was less likely to cause losses then at present when paper bags are used. It, therefore, is now more important then ever before to make sure that no unneeded material is ordered. When there is a question about the grade or size of Unionmelt that may be needed for any process application, the most probably correct grade and size should be ordered only in quantities sufficient to adequately determine its suitability.

Paper bags will not stand much more then one cycle of handling. Repackaging at our warehouses is impractical. Under any but the most extraordinary conditions, we will, therefore, have to make it clear to our customers that we will have to refuse to accept the return of Unionmelt in paper bags.

Very truly yours, F. G. Outcalt.

F. G. Outcalt/do

[fol. 1361] DEFENDANTS' EXHIBIT 98-B

THE LINDE AIR PRODUCTS COMPANY, NEW YORK

To: All District Sales Managers, All Division Sales Managers, All Division Service Managers, Unionmelt Division Engineers—N. Davis, E. D. Morris, N. G. Schreiner, All Unionmelt Division Representatives.

CC: General Sales Office, All Field Men.

March 6, 1943.

Unionmelt Division, General Letter—S-21
Unionmelt Welding Process
Organization, Reports, and Correspondence

GENTLEMEN:

The constantly growing number of Unionmelt users, the increasing volumes of reports and correspondence, and the broadening of the Unionmelt process experience of all Linde Sales and Service personnel make it desirable that the District offices depend more on the personnel in the Division Sales offices and less on the New York office of the Unionmelt Division for Unionmelt process assistance and guidance.

As has become the practice in several districts, all District offices should direct all questions pertaining to Unionmelt Welding Process, sales and service problems and procedures to the Division Sales Office to the attention of the Unionmelt Division Engineer (Division Process Service Managers in Southwestern and Pacific Divisions), with copies to the Division Sales or Process Service management and to the New York office of the Unionmelt Division. Except when necessary or when they are specifically requested to do so, no one in the office of the Unionmelt Division in New York will take action on copies of such correspondence or reports directed to individuals in the Division Sales offices.

The General Sales office, all Unionmelt Division representatives, Division Sales offices, and District Sales offices will be sent copies of all correspondence from the Unionmelt Division affecting policies or procedures. Correspondence directly from the New York office of the Unionmelt Division to customers will be kept at a minimum, but copies of all such correspondence will be sent to the affected District and

Division Sales offices and to the Unionmelt Division Engineer and to the General Sales office when desirable.

Copies of reports of sales and service personnel relating to Unionmelt users and to prospective licensees should be made as now specified for other reports and should include, in addition, one copy for the Division Sales Office, attention of the Unionmelt Division Engineer, and one copy for the New York office of the Unionmelt Division if the report contains important welding data, sales negotiation information, equipment criticisms or information, questions about unfilled customer's orders, comments on the attitude of customers, or other information which might be valuable to the field organization in contacts with customers or prospective customers doing similar work, or valuable for estimating material and equipment requirements or for determining policy. To facilitate routing and handling of reports when more than one subject is discussed, various subjects should be separated in paragraphs with subject headings whenever possible.

[fol. 1362]

General Letter S-21.
March 6, 1943.

Unionmelt Division personnel, except in emergencies when it may be impossible, will inform the District Management in advance of all Unionmelt Process service and engineering calls which they plan to make in the District, and whenever feasible a District representative, designated by the District Management, should accompany the Unionmelt Division representative so that District representatives may become more self-sufficient in Unionmelt activities, may have first-hand knowledge of all that transpires, and may help the District Management give the Unionmelt user or prospective licensee proper consideration in relation to other Linde processes, services, equipment, and materials. Division and District Sales and Process Service personnel and Unionmelt Division personnel by close collaboration can make available to each other through discussion and correspondence mutually beneficial information on sales and process problems and developments and thereby achieve close cooperation and the coordination of Linde Company activities.

Very truly yours, F. G. Outcalt.

F. G. Outcalt /do.

[fol. 1363] DEFENDANTS' EXHIBIT 98-C

THE LINDE AIR PRODUCTS COMPANY, NEW YORK

To: All District Sales Managers, All Division Sales Managers, All Unionmelt Division Engineers, All Division Service Managers.

CC: General Sales Office, Mr. A. H. Rodie, All Field Men (No Attachments).

March 8, 1943.

Unionmelt Division, General Letter—S-22
Unionmelt Welding Process
License Agreement Negotiations

Rod Purchase Contract Negotiations

GENTLEMEN:

New and revised Unionmelt Welding Process license agreement forms have just been prepared, and a copy is attached hereto. The important changes are in Section 1 of Article I (5 year license period) and in the old Section 1 of Article III, but there are several additional minor simplifications and improvements. It will be noted that the license fee rates printed in the forms are the same as in the previous forms and a copy of the license fee reduction letter of September 22, 1942 sent to all licensees should be addressed to each prospective new licensee and included with each license agreement form submitted. This should be stapled to the top of the page on which appears the section regarding license fees, and the date of preparation of the forms, in parentheses, should be noted below the signature. Additional forms and copies of the September 22nd letter are being sent separately to each Division Sales Office. The license agreement form should be used without alteration and even in very special cases no changes in or additions to the printed form should be made without approval in each instance from the Unionmelt Division Management in New York.

In the future, license agreement forms for presentation to prospective licensees should be prepared in the Division Sales offices, and the procedure outlined herein which is approximately the same as that now being followed in some Districts and Divisions, should be uniformly followed.

The District Sales and Service personnel, assisted and advised when necessary by Unionmelt Division engineers

and by District Process Service personnel experienced in Unionmelt Process problems, should assume the responsibility for finding and developing new users of the Unionmelt Welding Process. There are now perhaps more prospective Unionmelt users among fabricators of steel who are not Linde customers than among Linde customers, since many of the latter have already been licensed. However, constantly changing conditions and shortages of manpower and arc welding electrodes are creating new needs for the Unionmelt Process with many companies who previously could find no uses for it, and occasional rechecks should be made among all possible users.

Opportunities for the introduction of other Linde processes and services should, of course, not be overlooked at the time Unionmelt Process surveys are being made.

The general responsibility and credit standing of prospective Unionmelt Process users should be considered by the District management, and when necessary, should be checked with the Division Credit Departments before negotiations [fol. 1364] progress very far, and before quotations are submitted and terms of payment in the standard license agreement are quoted. If the standard license agreement terms of 'net payment 30 days after invoice' cannot be used, further negotiations may be unwise.

During all discussions of Unionmelt Welding costs with responsible persons and in all quotations and estimates of job costs whether oral or written, the fact that the process is available only under the terms of a standard license agreement should be mentioned. The license fee provisions should always be clearly explained to avoid any possibility of misunderstanding by responsible persons within the organization of the prospective licensee who may be talking about the process. In a few instances individuals finally responsible for decision have indignantly claimed to have had no knowledge of a license fee prior to the time the license agreements were submitted to them. Every effort should be made to avoid the possibility of such misunderstandings. Certain essential information outlined on a separate sheet attached hereto should always be transmitted in writing during routine negotiations, and much of it can conveniently be included in a quotation letter.

Recommendations for licensing prospective Unionmelt Process users should generally originate from the District Management, and should be directed to the Division Sales

Office, attention of the Unionmelt Division Engineer. Requests for license agreement forms should be accompanied by all information about the prospective licensee needed for preparing the forms, including the official name of the company, the address of the principal office, the type of organization (corporation, not incorporated, partnership, etc.), the state of incorporation (if incorporated), location of plants where process is to be used, and the approximate date when delivery of equipment and material may be required, or other comments to indicate proper starting date of the "license period".

The Unionmelt Division Engineer and Division Sales Management will consider the information on each prospective licensee and when a license agreement form is to be submitted, will prepare it and send two originals to the District Office. In preparing the forms the space for date on the first and second lines of the agreement should be left blank. The beginning month of the "license period" entered in Section 1 of Article I should be January, April, July, or October, whichever is the nearest *preceding* the date when the license agreement is submitted, or when first deliveries are to be made, or when the process is expected to be used. Although under special conditions we may be asked to fill orders for equipment and materials before license agreements have been signed by the licensee, the agreement should be signed first, or the purchaser must certify that the equipment and materials will not be used in violation of our patents, otherwise delivery and sale of equipment and materials might be construed as a license to use them in a way which would violate our Unionmelt Patent Rights.

When Purchase Contract forms for Unionmelt welding rod are to be submitted to a prospective licensee, they will be prepared and sent to the District Offices with the license agreement forms. The space for entering the beginning [fol. 1365] date of the contract should be left blank to be filled in at the time the contract is negotiated.

The rod purchase contract should not be presented or seriously discussed until after the license agreement forms have been presented to the prospective licensee, and when possible, the negotiation completed. Obviously a prospective licensee will have no need for special rod for Unionmelt welding until the agreement has been signed. This, however, should not be construed as an intention to limit the sale of the special rods designed for Unionmelt welding,

and they may be sold to anyone for any purpose either under the provisions of a contract, or without a contract at the standard "open market" price. Since welding rod is one item of cost and is the material involved in determining license fees, questions about purchasing it will undoubtedly be included as a part of the general discussion of a Unionmelt Process license, but, though the executive who will sign the license agreement may sometimes desire to sign the rod purchase contract at the same time, details of the rod purchase may best be discussed with the purchasing agent and the contract signed by him as a routine selling and purchasing problem. This procedure may sometimes complicate the purchase contract negotiations, but regardless of who signs the contract, it should always be remembered that the source of rod is optional with the licensee and that the two agreements, though both related to the same finished weld are entirely independent.

Since the rod purchase contract is only incidentally related to the license agreement, and since rod will not be used until after the installation is completed, the date in paragraph numbered 1 of the rod contract should preferably be later then the beginning date of the license period, and could most reasonably be approximately the date of the first rod shipment.

The license agreement must be signed by a "duly authorized" officer of the licensee (or by owner, partner, etc.). For a corporation, the president's or vice president's signature is unquestionably satisfactory, however, if other persons have been given authority to sign for the company with the same effect as the executive officers, their signatures are, of course, satisfactory if supported by proper evidence. This evidence may be a certified record of the minutes of the meeting of the corporation or of its officers and directors at which the authority was granted, or a certified record of other official action delegating executive powers to the signer. The license agreement involves patent licenses and mutual obligations between the licensee and licensor which are far more important than the obligations between purchaser and seller and violation might involve more than the loss of the business of an individual customer.

When the license agreement forms have been properly signed for the licensee, both originals should be forwarded from the District Office with a transmitting report or letter to the Division Sales Office attention of the Unionmelt Divi-

sion Engineer, with copies of the report or letter to the Unionmelt Division office in New York and to the General Sales Office. Complete data regarding the prospective licensee as required on the standard Linde report form #LAP 611B or 889A, should be included.

[fol. 1366] Rod purchase contracts signed by the customer and ready for acceptance should be forwarded to the Division Sales Office, attention of the Unionmelt Division Engineer, with copies of the transmittal letter sent to New York, addressed to the Unionmelt Division Office and General Sales Office.

When license agreements have been officially signed for Linde, the Unionmelt Division will send the Licensee's copy directly to the customer, and will send copies of the transmittal letter giving full information to the Division Sales Office, attention of the Unionmelt Division Engineer, the District, Division Accounting, Advice Book Department, General Accounting, and General Sales Offices.

When notice of the complete execution of the license agreement is received in the Division Sales Offices, the rod purchase contract may be accepted and the customer's copy returned to the District Office or to the Customer as determined by the Division Sales Management. A transmittal letter to the customer should be sent with this document with copy to the Unionmelt Division office in New York. At the same time the Unionmelt Division should be sent the form letter containing essential information about the the contract, (samples attached hereto for Division Sales office).

One signed copy of the rod purchase contract should be placed in the Division Sales Office files and handled the same as other automatic renewal gas group contracts. Proper notice should be sent to the Advice Book Department and others interested.

The District Sales office will be advised when to take care of "renewals" of standard license agreements and will receive new forms from the New York Unionmelt Division Office. These new agreements should be handled, in general, the same as were the initial agreements.

Very truly yours, F. G. Outcalt.

F. G. Outcalt /do. Attachments.

[fol. 1367] Outline of Essential Information Related to Licensing Negotiations To Be Transmitted to Prospective Unionmelt Welding Process Licensees

Paragraphs in "quotes" may be used as here written. Subjects mentioned in parentheses may generally best be presented orally.

"The Unionmelt Welding Process is made available for use under the terms of a standard license agreement with The Linde Air Products Company. The license agreement specifies, among other things, the prices of standard Unionmelt welding heads, the price of the granulated Unionmelt welding composition, and the license fee."

"There are various ways in which the standard welding heads, either complete or with modifications, are assembled with carriages and other accessory and special parts to produce welding machine assemblies which are sold as complete units. However, only the standard welding head prices are specified in the license agreement."

(All Unionmelt welding equipment is priced, sold, and delivered f.o.b. seller's factory at Newark, N. J.) Equipment prices should be quoted f.o.b. Newark, N. J.

(Unionmelt welding composition is priced, sold, and delivered f.o.b. manufacturer's plant at Niagara Falls, N. Y.) Unionmelt prices should be quoted f.o.b. Niagara Falls, N. Y. (Emergency stocks may at times be available at other points and when shipments are made from these stocks for the customers' emergency convenience, customers will be billed the extra transportation costs. If shipments from these stocks are made for Seller's convenience, the customer will be billed an amount to make total transportation costs the same as though the shipment had been made from Niagara Falls, N. Y.)

Three items enter into the "material" cost of Unionmelt welding,—welding rod, Unionmelt welding composition, and license fee. (Specify prices and rates for the particular conditions.)

(The license agreement provides for a charge for engineering service, however, bills are usually not rendered unless the service demanded is of longer than usual duration.)

(Though Unionmelt Process users, by purchasing welding rod from The Linde Air Products Company have assurance of getting material specially designed and prepared for use with the process, there is no reference in the license

agreement to the source of rod. The license fees for the use of the process are, of course, determined by the pounds of metal deposited regardless of the source of the rod.) (All rod for Unionmelt welding is priced, sold, and delivered f.o.b. Seller's warehouse.) Quote Oxweld #35 and #40 f.o.b. Pittsburgh, Pennsylvania; #36 f.o.b. Pittsburgh, Pennsylvania or Cleveland, Ohio at Seller's discretion depending on availability; #41 and #42 f.o.b. Cleveland, Ohio; other special alloy rods f.o.b. Cleveland, Ohio or Pitts- [fol. 1368] burgh, Pennsylania at Seller's discretion.

"Unionmelt welding equipment and welding rods are Class B-II products under the Controlled Materials Plan. Orders should bear C.M.P. certification and show allotment number and preference ratings. Most orders for Unionmelt equipment and welding rod are now rated AA-1 to AA-3, and high ratings will be required to assure reasonably prompt deliveries."

Note: Further information which may prove helpful in preparing quotation letters will be sent to all district offices in the near future.

Note: A review of Unionmelt Division General Letters S-9, S-10, S-16 (dated 1/5/43 and originally incorrectly numbered S-15), S-18, S-19, the last price letter, and letter dated October 8, 1941 (as corrected 10/20/41), may be helpful in answering questions which arise during license agreement and rod contract negotiations.

[fol. 1369] Inter-Company Correspondence

Company: The Linde Air Products Co. Location ——

To: Unionmelt Department. Location: New York, N. Y.

Date —— ——.

Attention: —— ——. Answering Letter Date —— ——.

Copy to: —— ——

Subject: Unionmelt Welding Process.

Gentlemen:

A completely executed standard contract with the subject company covering rod for Unionmelt welding has been placed in our files. The contract form has been filled in as indicated below:—

—— a corporation of . (hereinafter called the —— beginning on the day of ., 19 and . . . .

Submitted by —— ——, (Seller's Representative), Date —— ——. Accepted —— ——, (For the Seller), Date —— ——. —— ——, Buyer. By ——, Date —— ——.

Very truly yours, —— ——.

[fol. 1370] DEFENDANTS' EXHIBIT 98-D

The Linde Air Products Company

New York.
March 9, 1943.

To: All District Sales Offices (3).

CC; All Division Accounting Offices, All Division Sales Offices, All Division Managers of Process Service, All Unionmelt Division Engineers, Electro Metallurgical Company.

Unionmelt Division, General Letter S-23

Subject: Customers Orders, Customers Code Numbers

GENTLEMEN:

Many of you may already have received, and all should receive, from your Division Accounting Offices, Terms Cards which are regularly used by warehouses in preparing shipping orders. On these Terms Cards the Accounting Department code number for each Unionmelt process user is shown.

When you prepare the Unionmelt "Requisition for Material, Form LAP 1205 (E, A, or W)," please insert the customer's code number just above the customer's name and in the middle of the form. This number will then be transferred to the Shipper's Order forms when they are prepared in the Unionmelt Division office.

Very truly yours, F. G. Outcalt.

F. G. Outcalt do.

[fol. 1371] DEFENDANTS' EXHIBIT 98-E

Linde Air Products Company

New York.
April 12, 1943.

To: All District Sales Managers, All Division Sales Managers, All Division Service Managers, All Division Accountants, All Unionmelt and Division Representatives, General Sales Office, Messrs. G. P. Bogert, F. C. Hasse, D. S. Lloyd, T. C. Manton, Jr., A. H. Rodie, L. E. Ogden, F. A. Potts.

CC: All Field Men.

Unionmelt Division, General Letter S-26

Subject: Unionmelt Welding Process

Reduction in License Fee Rates

GENTLEMEN:

The letter quoted below and dated April 19, 1943 will be mailed as soon as possible to all Unionmelt Process licensees, addressed in most instances to the attention of the person who signed the license agreement.

"All Unionmelt Welding Process licensees of record as of this date have been informed by a letter dated September 22, 1942 that, to encourage further expansion of the already widespread applications of the process in the War Effort, the license fee was reduced, effective July 1, 1942, from that specified in the license agreement, to seven and one-half cents ($.075) per pound on the first fifty thousand (50,000) pounds and five cents ($.05) per pound on each pound in excess of fifty thousand (50,000) pounds of metal deposited by the use of the Unionmelt Welding Process in each fiscal year of the license period on production of materials used directly or indirectly in the War Effort.

"For the same reasons which prompted the previous reduction we are now pleased to advise you that, effective April 1, 1943 the license fee will be reduced to five cents ($.05) per pound on each pound of metal deposited by use of the Unionmelt Welding Process for the production of materials used directly or indirectly in the War Effort.

"This further reduction will continue in effect until the end of the present National Emergency."

Very truly yours, The Linde Air Products Company,
(Signed—F. G. Outcalt)"

This letter will be handled in the same way as the letter of September 22, 1942. Copies of the letter will be sent [fol. 1371a] separately to the Division Sales offices, as soon as they are prepared, for inclusion with license agreement forms when they are submitted to new licensees. They should be used the same as the September 22nd letters are now being used, and the September 22nd letter should be discarded.

As with the previous reduction of license fees, we will consider that all Unionmelt welding is "used directly or indirectly in the War Effort" since our equipment and materials would not be available except on high priorities.

Those prospective licensees to whom agreement forms have been submitted prior to the time when the April 19th letters became available should, when the supply of April 19th letters is received, be informed by letter from the individual or office which submitted the forms, that,

> "A letter like that attached hereto, dated April 19th, is being sent to all Unionmelt Process licensees and will alter the terms of the license agreement forms submitted to you recently."

This reduction in license fees will be particularly interesting to those licensees and prospective licensees who could expect but little or no advantage from the low rate for deposits over 50,000 pounds per year, but is, of course, a reduction for all users and should make our process even more attractive than it was previously.

Very truly yours, F. G. Outcalt.

F. G. Outcalt/do.

[fol. 1372] DEFENDANTS' EXHIBIT 98-F

LAP-Unionmelt Division

New York.
July 1, 1943.

To: All District Sales Managers, All Division Sales Managers, All Division Service Managers, All Unionmelt Representatives, General Sales Office, Messrs. G. P. Bogert, F. C. Hasse, D. S. Lloyd, L. E. Ogden, F. A. Potts (8).
CC: All Field Men.

General Letter S-32

Subject: Unionmelt Welding Process
Reduction of the Price of Unionmelt Welding Composition

GENTLEMEN:

The letter quoted below dated June 23, 1943, has been mailed to all Unionmelt process licensees, addressed in most instances to the attention of the person who signed the agreement.

"All Unionmelt Welding Process licensees of record as of the date of this letter have been informed by a letter dated April 19, 1943, that, to encourage further expansion of the already widespread applications of the process in the War Effort, the license fee was reduced, effective April 1, 1943, to five cents ($.05) per pound on each pound of metal deposited by use of the Unionmelt Welding Process for the production of material used directly or indirectly in the War Effort.

"A further economy in the use of Unionmelt Welding is now offered by a reduction in the price of the granulated 'Unionmelt' welding composition.

"For all 'Unionmelt' ordered for delivery or delivered on or after July 1, 1943 and during the present National Emergency, the price of five cents ($.05) per pound as provided in the license agreement will be changed to four and one-half cents ($.045) per pound f.o.b. plant of manufacture, subject to change as provided in the license agreement.

Very truly yours, F. G. Outcalt, Manager, Unionmelt Sales."

This letter will be handled in the same way as the letter of April 19, 1943, which was quoted in General Letter S-26. Copies of the new letter will be sent separately to the Division Sales Offices for inclusion with license agreement forms when they are submitted to prospective licensees. These new letters dated June 23 should be used in the same way as the letters of April 19 were previously used, and extra copies of the letter of April 19 should be discarded.

[fol. 1373] DEFENDANTS' EXHIBIT 98-G

LAP-Unionmelt Division

New York, N. Y.
September 13, 1943.

To: All District Offices, All Division Offices.

Subject: Requisition Forms for Unionmelt Welding Compound and Unionmelt Welding Rod

General Letter S-34

Heretofore it has been customary for the District Offices to request this department to supply them with the necessary requisition forms for Unionmelt Welding Compound and Unionmelt Welding Rod. Because of the burden of work going through this office this routine has been changed. In the future will all District Offices obtain their necessary requisition forms the same as they do their other supplies of stationery. These supplies are shipped directly from the printer.

To avoid any possible confusion in numbers please observe that from now on all requisitions for Unionmelt Welding Compound will be known as 1205-A. All requisitions for Unionmelt Welding Rod will be known as 1306-W.

Our supply of these forms is very limited. If any of the District Offices find that their stocks of these requisitions are low, we would suggest that they order them the same as their other stationery supplies at once. The responsibility for keeping themselves supplied with these necessary forms rests entirely with each District Office.

Very truly yours, E. E. Radcliffe.

E. E. Radcliffe, R.F.

[fol. 1374] DEFENDANTS' EXHIBIT 98-H

LAP-Unionmelt Division

New York 17, N. Y.
November 8, 1943.

To: All District Sales Managers, All Division Sales Managers, All Division Service Managers, Unionmelt Division Engineers.

CC: General Sales Office, Messrs. G. P. Bogert, D. S. Lloyd, A. H. Rodie, All Field Men.

General Letter S-39

Subject: New License Agreement Forms

"Duration" License Fees and Prices to Continue for Full License Period

GENTLEMEN:

The Unionmelt Welding Process license agreement form has again been revised and reprinted. One copy is attached hereto. A supply has been sent to the Division offices and six to certain District offices to be used in emergencies on authority of the Division Sales Management or Division Unionmelt Engineer. The new form differs from the one it supersedes in that:

It makes permanent, for the full license period, the reduced "Unionmelt" price (base) of $.045 per lb. (Article I, Section 3) and the reduced license fee rate (base) of $.05 per lb. of metal deposited (Article II, Section 2).

It shows the new price of $1750 for the basic Type U welding equipment (Exhibit A).

It includes two additional patents.

The sections in Article II have been rearranged, though there have been no important changes in wording.

All licensees, licensed under the old forms of agreement, are later to be notified of the changes through special procedure about which you will later be advised.

For the present please confine discussions of the permanent lower prices and rates to prospective new licensees and those old licensees who may specifically question you.

A review of Letter S-22 is recommended since all but the first paragraph is still applicable.

Very truly yours, F. G. Outcalt.

F. G. Outcalt/do.
Attach.

[fol. 1375] DEFENDANTS' EXHIBIT 98-I

New York 17, N. Y., February 21, 1944.

General Letter S-51

Subject: Unionmelt Welding Process.

Literature "Submerged Melt Welding" F-5263A

LAP—UNIONMELT DIVISION

To: All District, Division, and Field Personnel; The Oxweld Railroad Service Company; Dominion Oxygen Company, Ltd.

Gentlemen:

As most of you know our book "Unionmelt Welding—An Electric Welding Process" which was first printed in 1938 has been reprinted several times without revision, though the need for revision has been recognized by everyone familiar with the developments of the process and equipment since 1938. The central stock of this book has been exhausted and revisions of it are now being studied, but it will be some time before a new book is available.

Many of you are familiar with the chapter on Submerged Melt Welding, which appeared in the 1942 edition of The Welding Handbook, and with reprints of this chapter which have been available for the past several months. A large quantity of these reprints with a special cover have just been received from the printer and a sample is enclosed with each copy of this letter. Quantities are being sent to each district office for attachment to field personnel letters, and as an initial supply for general use. This pamphlet can be used in much the same way as we used our larger stock.

Though the title of the chapter is "Submerged Melt Weld-

ing" a footnote on Page 3 explains that the process described is generally known as the Unionmelt Welding Process. We believe the description, tables, and photographs in the chapter reprint together with the bibliography on the last two pages will make this little pamphlet acceptable to anyone who desires information about the process. We can circulate these pamphlets freely and supplies may be ordered through the Publicity Department in the same way that other company publications are obtained.

Very truly yours, F. G. Outcalt.

F. G. Outcalt/do.

[fol. 1376] DEFENDANTS' EXHIBIT 98-J

New York 17, N. Y., July 12, 1944.

General Letter S-58

Subject: New License Agreement Forms (Supercedes form sent with Letter S-39 of 11-8-43).

LAP—UNIONMELT DIVISION

To: All District, Division, and Field Personnel; The Oxweld Railroad Service Co.; Dominion Oxygen Company, Ltd.

Gentlemen:

One copy of a new Unionmelt Welding Process license agreement form is attached to this letter. A supply has been sent to each of the division offices and six copies to certain district offices to be used in emergencies on authority of the Division Sales Management or the Division Unionmelt Process Service Managers. The revisions in this latest printing of the form are more important than any revisions which have been made recently.

(1) It will be noted that the first paragraph of the agreement has been rearranged to eliminate the names of the Licensee's plants. In the original agreements the license was limited to certain specified plants known as "licensed plants". In the more recent agreements, though

the right to use the Unionmelt process was granted to the Licensee, it was sometimes erroneously assumed that the license and obligations applied only to the plants mentioned in the agreement. In this latest form there is no chance for misunderstanding either in the first paragraph of the agreement or in Article I Section 1 in which the license to use the process is specifically granted for "all plants in the United States operated by the Licensee".

We, of course, still wish to be informed of the location of plants in which the process is to be used, and in Article II Section 8 the Licensee agrees to notify us whenever it is proposed to use the process in any plants other than those which were considered at the time of the execution of the agreement and mentioned in Section 8. The Licensee has a right to use the process in any plant and is obligated under the agreement if the process is used in any plant, and though the Licensee agrees to tell us of his intent to use the process in additional plants, our own personnel should report any new points of use of our process by a licensee as promptly as possible, whether our equipment and material or competitive equipment and materials are employed.

(2) Two new patent numbers have been added to the list.

(3) In Article I, Section 1 the former limitation of the license to the use of the process "with steel welding rod electrodes in the welding of steel products" has been eliminated. The agreement now provides a license to use the Unionmelt process for the welding of any material, either steel or non-ferrous, and the license fee is $.05 per lb. of metal deposited regardless of the kind of metal. However, the types of Unionmelt regularly furnished at the price of $.045 per lb. may not be suitable for the welding of materials other than steel, and in Section 3 of Article I provision is made for the future sale of grades of Unionmelt "suitable for use in welding of materials other than steel at standard prices established by the licensor". We have not yet established prices on any of these special materials, but will establish them on the basis of their actual cost as they are developed.

[fol. 1376a] (4) A considerable change has been made in Section 1 of Article III. Between January 7 and 28, 1936 when the "composite market price of finished steel" was selected as the index of the domestic purchasing value of the dollar for the determination of prices and license fees, the

"Composite Price of Finished Steel" was determined by the publishers of "The Iron Age" by taking the average of the unit prices of a number of finished steel products which were sold in relatively large volumes. In October 1941 items selected for determining the composite prices were changed and our base index figure was altered to conform with these changes.

In 1943 and again more recently, the publishers of "The Iron Age" decided the unit prices of the individual items used in determining their "Composite Prices" should be weighed on the basis of sales of those products and should be revised at intervals as average sales volume changed. "The Iron Age" "Composite Prices" have therefore considerably "changed in form or character" and no longer represent an index of values but merely an approximation of the average price per pound of all the steel sold during a given period. Therefore the "Composite Prices" change depending on volume of each item sold and changes do not necessarily represent any change in the purchasing value of the dollar.

After considerable study we have decided to go back to the original basic idea of composite prices and develop our own "average market price" of steel, based on four classes of finished steel which seem most closely related to the products usually fabricated by the Unionmelt process. We have, therefore, consulted the publishers of "The Iron Age" and determined from their past records the prices of each of these items reported at the time the base price was selected for the original Unionmelt license agreements. The average of these prices, which is 1.825¢ per lb., now appears in the new agreement as the base price.

At the present time the average of the prices of the four selected items is 2.10¢ per lb., which is 15.06% above base. Theoretically we would be justified in increasing our prices 10%, however, a similar condition has existed with the old index for some time, but present conditions, of course, have precluded any increase in prices, even had we wished to increase them. There will probably not be any questions about this clause from prospective licensees who recognize the present conditions of price regulation. If existing agreements with the old index are still in force at some time in the future when conditions are different, we can notify licensees of the change. However, since general notification at this time would be of no importance and might be un-

necessarily confusing, we will avoid it unless a licensee raises a question about price.

(5) It will be noted that in Exhibit A the price of the Type U unit remains $1750, though, as you know, the present price is $1400. No change should be made in the agreement form. No additions should be made to Exhibit A to include other types of equipment until specific instructions are issued.

The new license agreement forms should be used as soon as they are received and any district or division office stocks of the old form should be returned to the New York Office, since we occasionally have need for extra copies of old forms and have no supply.

Very truly yours, F. G. Outcalt.

F. G. Outcalt/do; Attachment.

[fol. 1377] DEFENDANTS' EXHIBIT 98-K

New York 17, N. Y., November 20, 1944.

General Letter S-63

Subject: New License Agreement Forms (Supersedes forms sent with Letter S-58 of 7-12-44)

LAP—UNIONMELT DIVISION

To: All District, Division and Field Personnel; The Oxweld Railroad Service Company; Dominion Oxygen Company, Ltd.

Gentlemen:

The Unionmelt Welding Process license agreement form has again been revised, and one copy of the new form accompanies this letter. Large supplies have been sent to each of the division offices and six copies to each of the district sales offices to be used in emergencies on authority of the Division Sales Management.

To assure a thorough understanding of the new license terms, the forms should be carefully studied, and to assist in this study the changes from the previous standard form and the reasons for them are discussed below:

(1) Preamble. All numbers relating to patents on equipment have been deleted since no license is granted to make the patented equipment and the right to use it is implied by the sale of it. Only the numbers of those patents containing claims relating to the process or special methods of using it are included. All references to equipment have been deleted from the text immediately following the list of patent numbers, so as to completely exclude equipment patents from the definition of the term "Unionmelt Patent Rights".

(2) Article I, Section 1. The license period has been extended to June 9, 1953 which is the date of expiration of patent 2,043,960. It will be recalled that the original license agreements covered a period of three years, the more recent ones a period of five years. During negotiations of license agreements many prospective users of our process have objected to these limited periods, and frequently asked that a license be granted for the life of the principal process patent. Our policy has been changed to comply with these many requests.

During negotiations, prospective licensees may sometimes ask about cancellation privileges. No provision for cancellation has been made in the agreement, and is not considered necessary for the licensee or desirable for us. Since there is no minimum license fee provision and the license covers only the process as described in our patents, the licensee should have no legitimate reason to cancel the agreement. Even with our five year term, some prospective licensees have wanted to provide for cancellation before the expiration of the license period, giving as the reason the possibility that they might want to take advantage of some new or better process. Obviously such reasoning results from misunderstandings of our license agreement. There is no obligation in our agreement to use the process covered by our patents, and the existence of a license agreement is not against the interest of the licensee if he chooses not to use the process. If a new or better process is developed which is not covered by our patents, there is no reason why it should not be used. Furthermore, it any process is introduced which is covered by our patents, our licensee would be protected and would have a license to use it, whereas a non-licensee who used it would be infringing our patents.

License periods may be started on the first day of any month.

[fol. 1377a] (3) Article I, Section 3. References to the prices of Unionmelt welding heads formerly listed under "Exhibit A" have been deleted as has also "Exhibit A". We now agree to sell and deliver Unionmelt welding heads "at standard prices established by the Licensor". Only rarely do purchasers of equipment order the items formerly listed in "Exhibit A", and it is, of course, impractical to include in the license agreement the prices of the various modifications of the basic standard units of equipment or combinations of them with other equipment furnished by our company. The new wording merely assures that standard prices will be used in supplying all licensees.

(4) Article I, Section 4. References to improvements to "compositions of matter and or equipment" relating to the Unionmelt welding process have been deleted. It will be to our interests to advise the licensee of any substantial improvements to our "Unionmelt" or to equipment, and this will, of course, be done by offering for sale the best material and equipment we have available.

(5) Article II, Section 4. References to "Exhibit A" have been deleted.

(6) Article II, Section 6, (old agreement). Section 6 of the old agreement, under which the licensee agreed to grant us a license under all patents on improvements to the Unionmelt Patent Rights, has been eliminated from the new agreement. During the approximately ten years since the introduction of the Unionmelt process, no improvements have been obtained from licensees and it is probable that our own research and development will continue to keep ahead of the activities of the licensees. Furthermore the clause in the old section "; far as the licensee has a legal right to do so", probably made the section of somewhat questionable value to us. This section has, however, been one of the most controversial, and has delayed the satisfactory completion of negotiations and cost us more in time and effort than any other part of the agreement.

(7) Article III, Section 1. References to the prices of Unionmelt welding heads have been deleted, since these prices will be standard prices established from time to time by us.

The new form should make it easier to negotiate license agreements, and the extension of the license period to June 9, 1953 will certainly eliminate the work involved each few years in renegotiating agreements as they expire. The new forms should be substituted for any of the old license agreement forms which are now in the hands of prospective licensees and are not signed. Any of the old forms which have already been signed may, however, be accepted and sent to this office for execution. Copies of the new form prepared for licensees whose present agreements expire at the end of December of this year are being sent to the proper district offices, and it is hoped that they may be signed promptly and returned for acceptance.

Please send any remaining supplies of the old forms to the New York Office for possible future use.

Very truly yours, F. G. Outcalt.

F. G. Outcalt/do; Enc.

[fol. 1378] DEFENDANTS' EXHIBIT 98-L

LAP—UNIONMELT DIVISION

New York 17, N. Y., May 8, 1945.

To: All District Managers, all Division Managers, all Division Unionmelt Service Managers.

General Letter S-73

Subject: Unionmelt Welding Process. Licensing Negotiations.

GENTLEMEN:

There are many occasions during negotiations with Unionmelt process licensees, or non-licensees, who possess or are considering the purchase of equipment and materials other than ours which are suitable for use in the practicing of our process, when it becomes desirable to confirm by letter previous verbal explanations of our licensing arrangements, or by brief written presentation of our position to prepare the way for more effective discussions with responsible individuals.

During the past few months several such letters have been prepared, and typical examples of them accompany

this letter. If in your judgment any of these examples with suitable introductory and closing paragraphs should be used *exactly as written*, you may use them, sending copies of your letters to us in New York as well as to other interested offices and individuals. If special circumstances seem to indicate need for changes in the exact wording of these letters, please submit to us two copies of a double spaced typewritten draft of your proposed letter so that it may be carefully checked and approved in writing to you by either R. E. Cornwell or F. G. Outcalt before it is prepared for mailing. The use of air mail in submitting your draft to us and returning it to you will minimize delays.

It is hoped that you will recognize the reasons for and the importance of such careful consideration and approval, and that such letters will be prepared only with your personal approval and for your own signature.

Very truly yours, F. G. Outcalt.

F. G. Outcalt/do.
Enclosures.

[fol. 1379] (This letter was sent to the vice president of a non-licensed company who had a short while earlier started to use Submerged Melt Welding with equipment and materials not obtained from us.)

Dear Mr. Blank:

Mr. —— and I were pleased to have the opportunity to briefly discuss the "Unionmelt" Welding Process (last ——) with you and Mr. ——. Some of the things covered in previous conversations may bear repetition.

The "Unionmelt" Welding Process, also called the Submerged Melt Welding Process, has since its initial commercial applications about ten years ago, been made available to industry under the terms of a patent license agreement with our company. Two copies of our standard license agreement form, prepared for execution for your company, are submitted to you with this letter. This form is similar to those that have been executed by several hundred licensees, including a great number of the most important and and best known fabricators of steel products in the United States, as well as the Government of the United States.

You will note that the agreement form provides for a license to use the patented welding *process* as covered by

the claims of the "Unionmelt Patent Rights" as defined in the agreement. This agreement involves no obligation to purchase or use our equipment or materials, although our licensees generally prefer our equipment and materials because of highly satisfactory performance and economy.

In reviewing the patents listed in the agreement, you and your counsel may be particularly interested in patent #2,043,960. You may also be interested in reading published literature describing the "Unionmelt" Submerged Melt Welding Process. A reprint of Chapter 7 of the latest edition of The Welding Handbook of the American Welding Society, enclosed herewith, describes our process (though some of the tables of welding data are obsolete) and lists a partial bibliography of published literature which gives some indication of its widely recognized uses, even at the date the handbook was published.

Many users of equipment obtained from Lincoln Electric Company, Una Welding, Inc., Westinghouse Electric Company, General Electric Company, and others, have, after investigation, decided that the best use of such equipment for their purposes could be achieved by using our patented "Unionmelt" Welding Process and are operating under license obtained from us.

In using this process of welding and our materials, approximately one pound of our granular "Unionmelt" is used for each pound of welding rod deposited. Adding the cost of our Oxweld #36 welding rod in small coils at 7.6¢ per pound, our "Unionmelt" at 4.5¢ and the license fee at 5¢ per pound of metal deposited, we obtain a total cost of approximately 17.1¢ per pound of metal deposited. The cost of the rod and granular "Unionmelt" totals approxi- [fol. 1380] mately 12.1¢ per pound of metal deposited. We know of no other materials which are competitive in price or performance. Moreover, we give our licensees the benefit of our many years of experience with varied applications of our process regardless of the equipment or materials which may be employed.

We believe you realize that it will be to your economic advantage to use our process with our materials and are pleased that you have decided to investigate our process and patents. Regardless of your decision about future purchases of equipment, welding rod and granular "Unionmelt," we will be glad to work with you as a licensee under

our process patents. We will be pleased to hear from you when you have completed your investigation.

Very truly yours, ——— ———.

[fol. 1381] (This letter could be sent to a non-licensee after a very full discussion of the process and our licensing arrangements, and when it seemed likely that the licensee's personnel who were present during the discussion had a reasonably good understanding and appreciation of our position and the economies of using our material.)

DEAR MR. BLANK:

(After suitable introductory paragraph or phrase such as "Mr. ——— and I were pleased to have had an opportunity to talk with you regarding our Unionmelt Welding Process.")

As promised, I am sending you enclosed herewith two copies of our standard Unionmelt Welding Process license agreement form. Your attention is directed to the fact that this form when executed would become a license agreement for use of a *process*, and that as a licensee you would not be obligated to purchase or use welding equipment, welding rod, or melt (sometimes called "flux") obtainable from The Linde Air Products Company. However, our licensees generally prefer our equipment and materials because of highly satisfactory performance and economy.

We offer you a license to operate under our Unionmelt Patent Rights as defined in the license agreement form, and are submitting a copy of the reprint of Chapter 7 of The Welding Handbook of the American Welding Society describing the Submerged Melt or Unionmelt process, and also a copy of patent #2,043,960, which is the principal patent. This material indicates the advantages of the patented process, and the patent rights and protection we give to our licensees. It is the expiration date of patent 2,043,960 that is shown in the form as the end of the license period.

We look forward to hearing from you of your favorable consideration of our license proposal, and will be glad to work with you as a licensee toward your application of what we and many hundreds of users know to be a most satisfactory and economical method of automatic electric welding.

Very truly yours, ——— ———.

[fol. 1382] (A letter like this was sent to the president of one of our licensed company's to pave the way for a discussion of our process after a few unsatisfactory discussions with operating personnel who were unfamiliar with the exact terms of the license agreement and would assume no responsibility for the company's actions.)

DEAR MR. BLANK:

On a few occasions recently (our Mr. —— has) (I have) talked with your Mr. —— and Mr. —— about our Unionmelt Welding Process. I would like to discuss this subject further with you and would appreciate it if I might talk with you (next —— afternoon) when I will be in ——) or (at some later time to suit your convenience).

We understand that you have in your plant at ——, automatic electric welding equipment obtained from (The Lincoln Electric Company). Many users of this type of equipment, as well as users of automatic welding equipment obtainable from (Una Welding, Inc.) General Electric Company, Westinghouse Electric Company, and others, have, after investigation, decided that the best use of such equipment for their purposes could be achieved by using our patented Unionmelt Welding Process and are operating under a license obtained from us.

Since your company is already a Unionmelt process licensee, the desirability of using this equipment with our process may have been considered.

It may be that in using equipment and materials not obtained from us, your operating personnel have assumed that your company is necessarily operating outside of the Unionmelt process license agreement. We ask that you consider the provisions of the agreement to determine whether what is being done or is planned is, in fact, Unionmelt welding under the agreement.

When you review the Unionmelt process license agreement, you will note that it provides for a license to use the welding *process*, and the Unionmelt welding composition, as covered by the claims of the Unionmelt Patent Rights as defined in the agreement. The agreement involves no obligation to purchase our equipment or materials for use with the process, and the type of equipment and materials, or the source of such equipment or materials, bears no relation to your rights under the agreement to use the process

or our rights to receive payment for the use of the process. For your convenience, a copy of patent #2,043,960 which describes the process, is enclosed with this letter, as is also a reprint of Chapter 7 of The Welding Handbook of the American Welding Society which describes our process.

I hope to have an opportunity to convince you that the costs of using our process with our Unionmelt will be considerably less than the costs of using other materials for [fol. 1383] our process, and if you desire it, we will be pleased to arrange for a demonstration with the hope of proving that there are grades of Unionmelt which we can furnish at $.045 per lb. f.o.b. shipping point, which are equal to or superior to any similarly usable material available from other sources at much higher prices. We look forward to seeing you (next week).

Very truly yours, —— ——.

[fol. 1384] (This letter was sent to a vice president of a non-licensed company with whom one of our salesmen had discussed our process and license agreement after learning of the use of what seemed to be our process with equipment and materials which the company had purchased from The Lincoln Electric Company. This vice president had written to us asking about their status in connection with our patents.[3]

Dear Mr. Blank:

Thank you for your letter of (——) referring to our Mr. ——'s visit and the discussion of the Unionmelt Welding Process.

Many users of the type of equipment which we understand you have purchased, as well as users of automatic welding equipment obtainable from Una Welding, Inc., General Electric Company, Westinghouse Electric Company, and others, have, after investigation, decided that the best use of such equipment for their purposes could be achieved by using our patented Unionmelt Welding Process, and are operating under a license obtained from us. Presumably, your situation is similar.

The Unionmelt Welding Process, also called the Submerged Melt Welding Process, has, since its initial commercial application some ten years ago, been made available to industry under the terms of a patent license agreement

with our company. (Two copies of our present standard license agreement form, prepared for execution for your company, are submitted with this letter. This is the same agreement form) or (The license agreement forms which have been submitted to you are the same forms) which (have, has) been investigated and accepted by a large number of the most important companies in the United States and by the Government of the United States.

You will note that the agreement form provides for a license to use the welding *process*, and the "Unionmelt" welding composition, as covered by the claims of the Unionmelt Patent Rights as defined in the agreement. This agreement involves no obligation to purchase our equipment or materials for use with the patented process.

In reviewing the patents listed in the agreement, you and your patent counsel may be particularly interested in patent #2,043,960, copy of which accompanies this letter. You may also be interested in reading published literature describing the "Unionmelt" Submerged Melt Welding Process. A reprint of Chapter 7 of the latest edition of The Welding Handbook of the American Welding Society, enclosed herewith, describes our process (though some of the tables of welding data are obsolete) and lists a partial bibliography of published literature which gives some indication of its widely recognized uses, even at the date the handbook was published.

In using this process of welding and our materials, approximately one pound of our granular "Unionmelt" is used for each pound of welding rod deposited. Adding the cost of our Oxweld #36 welding rod in small coils at 7.6¢ per pound, our "Unionmelt" at 4.5¢ [fol. 1385] and the license fee of 5¢ per pound of metal deposited, we obtain a total cost of approximately 17.1¢ per pound of metal deposited. The cost of the rod and granular "Unionmelt" totals approximately 12.1¢ per pound of metal deposited. We know of no other materials which are competitive in price or performance. Moreover, we give our licensees the benefit of our many years of experience with varied applications of our process regardless of the equipment or materials which may be employed.

Full consideration of costs, our servic program, and the production results obtainable with our materials and equipment should convince you that we have offered you in the Unionmelt Welding Process a most economical and satis-

factory means of welding, and we trust that your company will decide to become a licensee under our Unionmelt Welding Patent Rights, and that we may have the pleasure of working with you.

Very truly yours, —— ——.

[fol. 1386] (Please attach to sample letters sent with General Letter S-73).

DEAR MR. BLANK:

Several weeks ago we discussed the Unionmelt Welding Process (sometimes called Submerged-Melt Welding), and since we have not heard from you, it may be worthwhile to restate our position with relation to some of your activities. Although copies of our standard license agreement forms under which we offered you a license to use our patented process were (sent or given) to you, they may have been mislaid and therefore additional copies are enclosed with this letter.

We understand that you have in your —— plant, automatic welding equipment obtained from (The Lincoln Electric Company). Many users of this type of equipment, as well as users of automatic equipment obtained from (Una Welding Inc.), General Electric Company, Westinghouse Electric Company, and others, have, after investigation, decided that the best use of such equipment for their purposes could be achieved by using our patented Unionmelt Welding Process, and are operating under a license obtained from us.

It may be that in using equipment and materials not obtained from us, your operating personnel have assumed that regardless of the methods employed, your company is necessarily operating outside of the claims of what we define in our license agreement form as the Unionmelt Patent Rights. For your own satisfaction, you or your patent counsel may wish to review patent #2,043,960, copy of which is enclosed with this letter, as well as the Unionmelt license agreement form. You will note that the proposed agreement provides for a license to use a process. Under the agreement you would incur no obligation to purchase or use equipment or materials which we offer for sale, but would obtain full protection in your use of the process which has been adopted by many of the most important welding fabricators.

If you have applications for welding in which a separately

applied granulated material can be used for submerging, concealing, shielding, or protecting the welding zone, you can undoubtedly use our process. Full consideration of the costs of our materials, our reasonable license fee, our service program, and the production results obtainable with our materials and equipment, should convince you that we have offered you a most economical and satisfactory means of welding, and we trust that your company will decide to become a licensee under our Unionmelt Welding Patent Rights, and that we may have the pleasure of working with you.

Very truly yours, —— ——.

[fol. 1387] (This letter was sent to the patent counsel consultant of a non-licensed company after brief presentation of our story, so that he might have necessary information for checking our position.)

DEAR MR. BLANK:

(We very much appreciated your kindness in seeing us Tuesday morning and listening to our comments about the "Unionmelt" Welding Process.)

As brought out during our conversation, several users of Lincoln Electric Company equipment and materials of the type your company are using for some of their work, have found that the most economical and best results could be obtained with this equipment and material by using it in the practice of the process covered by the "Unionmelt Patent Rights" as defined in our standard license agreement form.

Though two copies of this form were submitted some time ago to your Mr. ——, another set of copies is included herewith for your convenience. You will note from this form, as was also emphasized during our conversation, that the license which we offer is for the use of our patented *process*, and that the agreement in no way restricts the licensee to the use of any special equipment or materials. However, our licensees generally prefer our equipment and supplies because of highly satisfactory performance and economy.

You may be particularly interested in patent #2,043,960, which is among those listed in the agreement form. It is the expiration date of this patent that has been used in the license agreement form as the expiration date of the license period.

You may also be interested in reading published literature describing the "Unionmelt" or Submerged Melt Welding Process. The description in Chapter 7 of The Welding Handbook of the American Welding Society, has been reprinted and a copy of it accompanies this letter. The partial bibliography in this reprint will give some indication of the wide use of the process and its long recognized position in the steel fabricating industry. Among our hundreds of licensees are included most of the important steel fabricators in the United States, and the Government of the United States. All agreements provide for a uniform license of 5¢ per pound of material deposited by the use of the process.

In using the "Unionmelt" Process and our materials, approximately one pound of our granular "Unionmelt" welding composition is used for each pound of welding rod deposited, and for welding ordinary steel the total cost of materials and process is approximately 17.1¢ per pound of rod deposited. This is the sum of 7.6¢ per pound for our Oxweld #36 welding rod in small coils, 4.5¢ per pound for "Unionmelt" and 5¢ per pound of rod deposited for license fee. The cost of our materials alone is approximately 12.1¢ [fol. 1388] per pound of metal deposited. We know of no other materials which are competitive in price. Moreover, we give our licensees the benefit of our many years of experience with varied applications of our process regardless of the equipment or materials which may be employed.

We believe that your investigation of our process and full consideration of our costs will convince you and the ——Corp. that we have offered in the "Unionmelt" Welding Process a most economical and satisfactory means of welding, and we trust that the —— Corp. will decide to become a licensee under our "Unionmelt Patent Rights."

Very truly yours, —— ——.

[fol. 1389]. DEFENDANTS' EXHIBIT 98-M

LAP—UNIONMELT DIVISION

New York 17, N.Y., May 21, 1945.

General Letter S-74

To: All District Managers, All Division Managers, All Division Managers, Unionmelt Service.

Subject: Unionmelt Welding Process. Orders from Non-Licensees.

GENTLEMEN:

A few companies, not licensed to use our Unionmelt Welding Process and our Unionmelt welding composition, have asked us for quotations or given us formal orders for the delivery of our material. We have, of course, an obligation under our license agreement to furnish our patented Unionmelt welding composition to licensees, but are under no obligation to sell it to others to whom we have not granted a license to use it.

If an order for Unionmelt welding composition is received from a non-licensee and he cannot demonstrate that the material is to be used for purposes other than for practicing the patented process, he should be told that the material is patented, that we know of no use for the material except with our process, and that we will be pleased to enter into our standard license agreement with him. If he insists on delivery of the material without a license, tell him that we will not sell our material for use in infringing our patents, and if he questions such a statement on the basis of a WPB preference rating applied to his order, you may say that it is your understanding that Priority Regulations do not require acceptance of a rated order from a person unwilling to meet regularly established terms of sale. If an argument seems to be developing which may cause trouble, the entire problem may be referred to the New York Office.

In this connection the following is quoted from Priorities Regulation No. 1, Paragraph 944.2, and may be referred to in conversation.

"(e) A rated order need not be (but may be) accepted in the following cases, but there must be no discrimination in such cases against rated orders, or between rated orders of different customers:

(1) If the person seeking to place the order is unwilling or unable to meet regularly established prices and *terms of sale* or payment. (When a person who has a rating asks a supplier to quote his regularly established prices and terms of sale or payment, the supplier must do so . . . . However, the supplier need not quote if he is not required to accept the rated order and knows that he will not do so if he receives it.)"

[fol. 1390] We desire to quote whenever we receive an inquiry. However, in quoting on "Unionmelt" to a non-licensee, after suitable introduction referring to the inquiry, use the following:

> "Unionmelt" welding composition is a patented material, and as far as we know, is used only in the patented Unionmelt (Submerged Melt) Welding Process. Accordingly, this quotation shall constitute an offer to sell only if and when you become a licensee under our standard license agreement, or show us that you have some use for the material which will not infringe our patents. The present price of granulated "Unionmelt" welding composition of grades suitable for use in the welding of steel, as determined by the terms of said license agrement, is $.045 per pound f.o.b. plant of manufacture plus the amount of any sales or other excise taxes imposed on the Seller by reason of the sales or deliveries."

The quotation should also state our willingness to enter into our standard licensing agreement for the use of the process and materials. If the prospective licensee is unfamiliar with our agreement form, copies of it may be sent with the quotation with appropriate explanations that the process license is offered without regard to the materials to be employed, or the prospective licensee may be informed that our company representative will visit him soon to further discuss the agreement and our offer of a license to use the process and material.

In special instances it may be desirable to have a prospective licensee try our materials, and authorization may be requested from the Unionmelt Division Office in New York through the Division Manager, Unionmelt Service, for a Linde representative experienced with Unionmelt welding, to take the material into the user's plant, stay with it while

it is being tried to see that it is used to the best advantage, and take out any unused material. Such demonstration or trial Unionmelt will ordinarily be furnished without charge to the prospective user.

Please notify the Unionmelt Division in New York (by letter giving full particulars) of any orders or requests for quotations on equipment or materials from companies not licensed to use our process.

Very truly yours, F. G. Outcalt.

F. G. Outcalt/do.

[fol. 1391] DEFENDANTS' EXHIBIT 98-N

LAP—UNIONMELT DIVISION

New York 17, N.Y. July 11, 1945.

To: All District, Division, and Field Personnel, The Oxweld Railroad Service Co., Dominion Oxygen Company, Ltd.

General Letter S-76 (S-73 sent only to Division and District Managers)

Subject: Unionmelt Welding Process.

Advertising

GENTLEMEN:

With this letter is a reprint of an advertisement and a list of 34 United States publications in which it is currently appearing. The list has been carefully selected by our Publicity Department to include a special circulation group, where it was thought that the advertisement would do the most good.

You will note that the illustration of Unionmelt welding has been simplified to its essentials, and those of you who have seen recent advertising by The Lincoln Electric Company will recognize that their illustration cannot be distinguished from what we have been showing for years. Our advertisement is the first which has stressed our patents, and is one of a series of three which will appear in the same publications during succeeding months. Reprints of the other advertisements will be sent to you later.

The advertisement should be particularly interesting to users of equipment and materials other than ours who may

have neglected to properly consider our process patents. A number of copies of the reprint are being sent to each district office, and prompt use should be made of them, particularly with those licensees or non-licensees who are using materials other than ours for the practice of what many people agree is the process covered by our patent No. 2,043,960. Many of these companies have already been sent letters explaining our position and referring to our patented process. To those who have been sent these letters, a letter something like the following may be suitable for transmitting the advertisement reprint.

Dear Mr. —— ——:

In connection with our letter of —— —— you may wish to add to your file on Unionmelt welding our advertisement which is appearing currently in many business papers. The reprint enclosed with this letter is for your convenience.

Very truly yours, —— ——.

In some instances where there has been no answer to the S-73 type letter, an additional reference to it could be made in the above letter, with the idea of fostering a written reply.

[fol. 1392] The advertisement reprint may also be given or sent to any of our licensees or prospective licensees, it being of particular interest perhaps to those who have already heard of competitive materials and equipment and so-called different processes, but if may be used advantageously with anyone.

District managers or others who are involved in negotiations with non-licensees or licensees who are using materials other than ours, may find it particularly effective to use this advertisement, preferably in one of the publications, in discussions, and may find it effective to leave a reprint with the person with whom such discussions are held, or send a reprint of the advertisement with further letters of the type which accompanied General Letter S-73.

The advertisement may be used with licensees or prospective licensees even though they have not considered any competitive materials or equipment or have not been subjected to competitor propaganda regarding our patents and license agreement.

Regardless of the means employed we would like to be sure that every licensee and every prospective licensee are sent copies of the reprint as soon as possible.

The Report No. 6 on the uses of Linde methods in mass production which is devoted entirely to Unionmelt welding, will be available within the next few weeks, and copies of it will be circulated throughout our organization at the time it appears in various publications.

Very truly yours, F. G. Outcalt.

F. G. Outcalt/do. Enclosures.

[fol. 1393] The Advertisement

"This Is Unionmelt Welding"

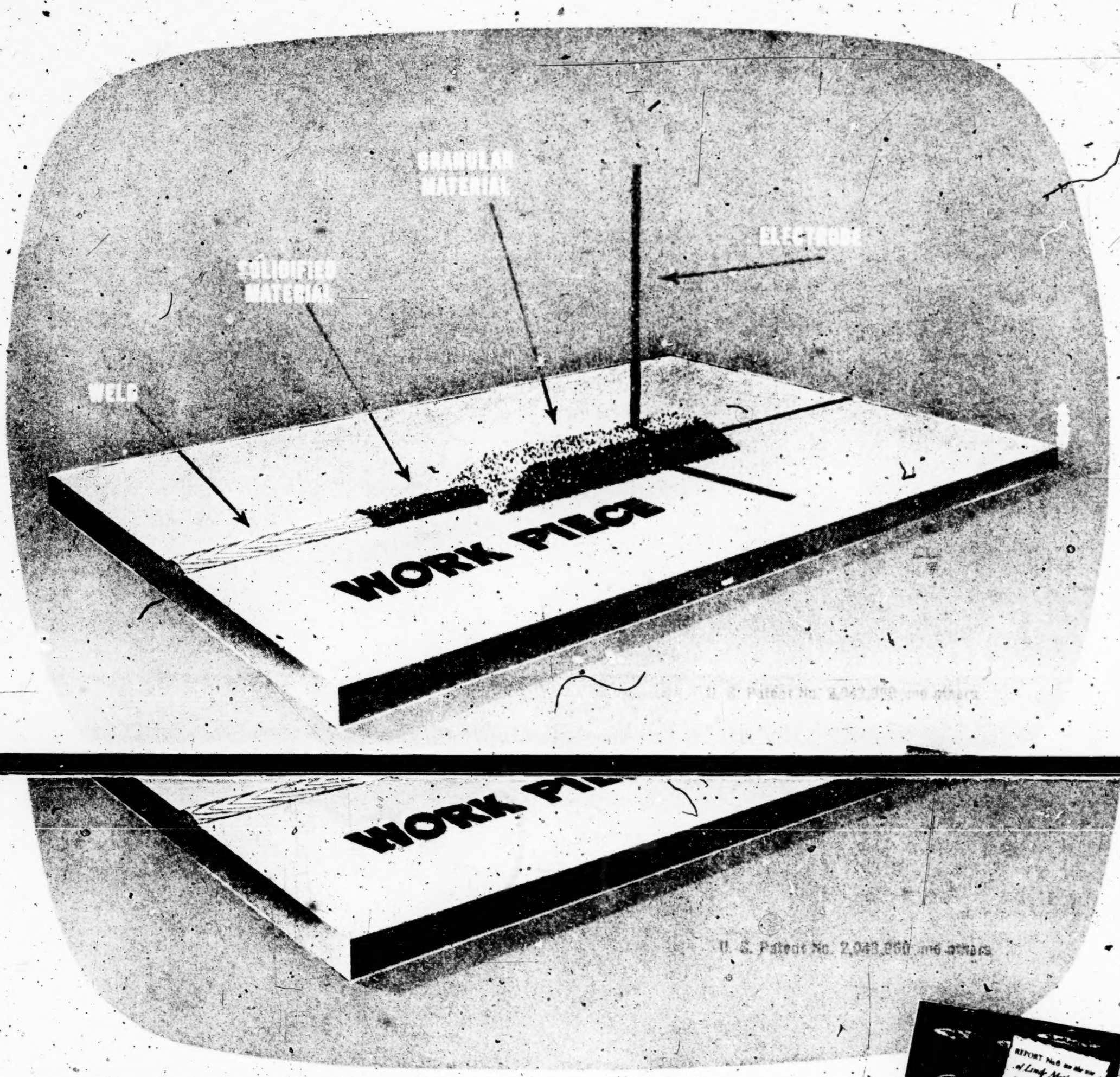
Is Scheduled To Appear In The Following Publications

Publication	Issue	Circulation
American Machinist	July 5	25,821
Auto. & Aviation Industries	July 15	11,850
Blast Furnace & Steel Plant	July	3,348
Business Week	June 30	125,044
Civil Engineering	July	19,882
Electrical World	July 7	18,387
Engineering News Record	June 28	35,221
Factory Mgmt. & Maintenance	July	33,559
Industrial Equipment News	July	44,533
Industry & Welding	July	25,113
Iron Age	June 28	18,933
Iron & Steel Engineer	July	4,012
Machine Design	July	10,778
Machinery	July	20,681
Marine Engrg. & Ship. Review	July	8,542
Mechanical Engineering	July	18,486
Metal Progress	July	18,340
Metals and Alloys	July	16,449
Mill and Factory	July	30,317
Modern Industry	July	51,217
New Equipment Digest	July	44,843
Oil & Gas Journal	June 30	16,851
Oxy-Acetylene Tips	October	29,613
Pacific Marine Review	July	3,681

Petroleum Engineer	July 1	10,741
Power	July	26,361
Purchasing	July	8,511
S.A.E. Journal	July	11,522
Steel	June 25	14,705
Steel Processing	July	4,066
Welding Engineer	July	10,502
Welding Journal	July	9,200
Western Construction News	July	8,997
Western Industry	July	7,271
Western Metals	July	4,216

(Here follows 1 Photolithograph, side folio 1394)

THIS IS UNIONMELT WELDING



UNIONMELT Welding is easy to recognize. It is electric welding done as diagrammed above—and it makes top quality welds at speeds that are greater than with any other similarly applicable process!

UNIONMELT Welding, a process of welding electrically beneath a mineral melt, has received wide application since U. S. Patent No. 2,043,960 was issued. It is the electric welding process that is rated by many as one of the most important factors in the great wartime fabrication of steel.

Anyone may obtain a license to use UNIONMELT Welding through its developers—The Linde Air Products Company.

Linde can supply a wide variety of equipment and materials to apply UNIONMELT Welding. Linde representatives can help you determine where you can use the UNIONMELT process advantageously and what type of equipment is best suited to your work.

For additional information send for the folder "Report No 6 on the Use of Linde Methods in Mass Production."

MARITIME "M" AWARD FOR OUTSTANDING PRODUCTION ACHIEVEMENT

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

The word "Unionmelt" is a registered trade-mark of The Linde Air Products Company

★ BUY UNITED STATES WAR BONDS AND STAMPS ★

P-17945

[fol. 1395] DEFENDANTS' EXHIBIT 98-O

LAP—UNIONMELT DIVISION

New York 17, N. Y.,
August 1, 1945.

General Letter S-76a (Refer to S-76)

To All District, Division, and Field Personnel, The Oxweld Railroad Service Co., Dominion Oxygen Company, Ltd.

Subject: Unionmelt Welding Process.. Advertising.

GENTLEMEN:

The second of our series of advertisements announced in General Letter S-76 dated July 11 has started to appear in the same publications that carried the first of the special advertisements which stressed our patents. A reprint of the second advertisement accompanies this letter, and attached to it is a printed slip listing the publications in which it is appearing.

From some districts we have received no copies of letters or other evidence that the supply of the first advertisement sent to each district has been mailed or otherwise used to advantage. Obviously the advertising campaign will be more effective if we use the reprints to the best advantage, and we want to get as wide a circulation of these reprints as possible among our licensees and prospective licensees. A supply of the latest reprints and the slip telling where the advertisement is appearing is being sent to each district office.

A supply of "Report No. 6 on Uses of Linde Methods in Mass Production" is also being sent to each district office. Future requests for this reprint which come to the New York office will be forwarded to the districts for answer. A few requests have already been received and filled from a small sample lot of the Report No. 6 which first came from the printer. Report No. 6 can also be effectively used with prospective users of Unionmelt welding as a first piece of literature to give a general idea of the scope of the process.

Very truly yours, F. G. Outcalt.

F. G. Outcalt do.
Enc.

[fol. 1396] DEFENDANTS' EXHIBIT 98-P

LAP—UNIONMELT DIVISION

New York 17, N. Y.,
August 20, 1945.

To All District, Division and Field Personnel, The Oxweld Railroad Service Co., Dominion Oxygen Company, Ltd.

General Letter S-76b (refer to S-76 and S-76a)

Subject: Unionmelt Welding Process. Advertising.

GENTLEMEN:

The third of our series of advertisements announced in General Letter S-76 dated July 11 will soon be appearing in the same publications that carried the first two of the special advertisements which stressed our patents. A reprint of the third advertisement accompanies this letter, and attached to it is a printed slip listing publications in which it will appear.

This further statement of the advantages of Unionmelt welding and reminder about our patents should be distributed either with or without a special letter wherever it will be of interest, both to licensees and non-licensees. A supply of this advertisement and the printed slip is being sent to each district office.

Very truly yours, F. G. Outcalt.

F. G. Outcalt/do.
Enc.

[fol. 1397] DEFENDANTS' EXHIBIT 98-Q

LAP—UNIONMELT DIVISION

New York 17, N. Y.,
October 17, 1945.

General Letter S-77

To All District, Division, and Field Personnel

CC: Dominion Oxygen Company, Ltd., The Oxweld Railroad Service Company.

Subject: Unionmelt Welding Process. Patent Suits.

GENTLEMEN:

As some of you have already learned from various sources, a suit was instituted October 1 in the District Court of the United States for the Northern District of Indiana by The Linde Air Products Company against Graver Tank and Manufacturing Co., Inc., in connection with the use of the Unionmelt Welding Process. The Lincoln Electric Company was named as co-defendant. This action charges both parties with infringement of our patent No. 2,043,960. Most of you have copies of this patent and are familiar with it.

The Graver Tank and Manufacturing Company of East Chicago, Ind. was an early user of Submerged Melt Welding with Lincoln "flux" and has never accepted our offer of a license.

In the complaint Linde demands an injunction against further infringements, and accounting for profits and damages, and assessment of costs against the defendants.

On October 8 The Lincoln Electric Company filed suit in the District Court of the United States for the Northern District of Ohio against The Linde Air Products Company for infringement of their expired U. S. Patent No. 1,589,017. In the complaint Lincoln demands a judgment for $100,000.

Lincoln's Patent 1,589,017 was issued June 15, 1926 on an application filed October 11, 1918. The patent expired June 15, 1943. The patent is well known to us.

Our suit was instituted only after serious consideration by our organization and was undertaken with full confidence in the strength of our position. Lincoln's suit is separate

and distinct and has no bearing on ours and does not alter the point at issue in our suit which is the infringement of our patent.

Except for a brief report of the filing for the Linde vs. Lincoln action, which appeared in a Hammond, Indiana and a Chicago newspaper on October 2, we have sought no newspaper publicity. The place to try a lawsuit is in court, not in the newspapers.

In accordance with usual Lincoln practice, announcement of the Lincoln vs. Linde suit received wide circulation as an Associated Press release. In this news item J. F. Lincoln is reported as stating "that the alleged infringement was on a patent taken out a number of years ago for a method of arc welding 'which consists of surround-[fol. 1398] ing molten metal with an inert medium.' 'This suit,' said Lincoln, 'follows one filed October 2 in Chicago by The Linde Air Products Company to prevent industry from obtaining the benefits from our Lincolnweld automatic process of shielded arc welding' ".

It is well known to all of you that Linde has never tried to prevent anyone from using any welding process, materials or equipment. Our only concern has been to prevent the piracy of our patented process without the payment to us of the reasonable royalties to which we are justly entitled by law. We have among our licensees, many who, having bought Lincoln equipment and materials have decided that what they wanted to do with them was covered by our patents and that the most benefit could be obtained by using our patented process. Such Lincolnweld equipment and material users have taken a license from us, have benefited from our service, and have obtained more economical and often better results than when depending on Lincoln materials and experience. The benefits of Submerged Melt Welding have not been and certainly will not be withheld from industry, since we offer licenses to *anyone* and also offer materials which users have found make it possible to weld at lower costs, including licensing fee, than when Lincoln materials were used and our process license fee ignored.

Our suit is based on a patented process which we have actively developed and promoted at great expense over a period of years. By promoting our patent, an outstanding contribution has been made to the practice of welding, which during recent years, was fortunately of much importance to the War Effort.

It is common knowledge that nothing like Unionmelt welding was promoted by Lincoln in the period from 1918, the date of Lincoln's patent application, until after our Unionmelt process had filled an important place in industry. If there are to be any accusations of abuse of patents and preventing industry from using an improved more economical process, it might seem that the accusation could be made against one who after twenty years of doing nothing and after a process was successfully introduced by another, claims that he knew it all the time and had it covered by a patent.

It is certainly not up to us in the sales or service organizations to attempt to argue the cases with anyone. They will be decided by the courts.

As a Linde representative, you perhaps will be questioned about these suits. The information in this letter is little more than has appeared in the newspapers. There is nothing more to say at this time. It will undoubtedly be several months before the cases are decided, and in the meantime, our attitude toward licensees and non-licensees who may not have agreed with our ideas about Unionmelt patent rights, should continue about as it has been in the past. We will continue our active offers of licenses to anyone wanting to use our process as described in Patent 2,043,960. We will continue to record our attitude toward the use of our process and of materials and equipment from any source by conversation and letter as outlined in General Letters S-73, S-76, S-76a, S-76b. We want to continue to avoid anything [fol. 1399] which might be construed as an accusation of infringement or a threat of legal action. The fact that one such action involving not only a fabricator but The Lincoln Electric Company, has been started, should be sufficient evidence of our serious intentions regarding our patent rights.

It is reasonable to assume that Lincoln representatives will develop their own impressive story about the two suits when negotiating future equipment and material sales. Our policy, until there are future instructions, will be to avoid any but casual mention of the suits, to attempt to promote customer good will, and to sell our process, materials, and service on the basis of performance and economy.

In spite of the fact that Lincoln has recently reduced the price of flux to $.10 per lb., the use of Lincoln material with-

out considering license fee generally results in higher cost of welding than if our materials were used and the cost of the license added. Many users have determined that there is more of the Lincoln flux fused than of our Unionmelt in making a weld. Furthermore, the inevitable wastes and losses of unfused granular material are much more expensive when the material costs $.10 per lb. than when it costs $.045 per lb.

Linde's record in offering service, equipment, and materials to all industry at the lowest overall cost and of having offered these things ever since the process was first invented, certainly indicates the opposite of trying to prevent industry from benefiting from the invention. With the knowledge that our company has, as soon as possible after the end of the war, taken aggressive action against an important infringing fabricator and against The Lincoln Electric Company, let us make special efforts to "sell" our process, our license, our materials, and our equipment to every fabricator who may have use for them.,

Very truly yours, F. G. Outcalt.

F. G. Outcalt/do

[fol. 1400] DEFENDANTS' EXHIBIT 98-R

LAP—UNIONMELT DIVISION

New York 17, N. Y.
November 16, 1945.

To: All Division, District, and Field Personnel, The Oxweld Railroad Service Co., Dominion Oxygen Co., Ltd.

General Letter S-78

Subject: Unionmelt Welding Process
Patent Suits

GENTLEMEN:

It has been reported that in a few places representatives of The Lincoln Electric Company have been making misleading or at least uninformed statements to their customers and ours regarding the suits between Linde and Lincoln. We would like to receive special detailed and ac-

curate reports regarding any such statements, which without asking for them, you may hear about during the negotiation of Unionmelt business. We are also interested in the attitude of users and prospective users of our process toward the suits.

Although General Letter S-77 discouraged participation in discussions of the patent suits and that policy should still be followed, those who have been subjected to Lincoln propaganda may be lead to repeat it to a good listener.

It would be appreciated if you would send two copies of the report to the Unionmelt Division Office.

Very truly yours, F. G. Outcalt.

F. G. Outcalt/do.

[fol. 1401] DEFENDANTS' EXHIBIT 98-S

LAP—UNIONMELT DIVISION

New York 17, N. Y.
Date: July 12, 1946.

To: All District Managers, All Division Managers, All Division Unionmelt Service Managers.

General Letter S-84

Subject: Unionmelt Welding Process

Users of Materials and Equipment from Other Suppliers

GENTLEMEN:

Since the beginning of competitive activities in the selling of Submerged Melt (Unionmelt) Welding Process, equipment, and materials, all field reports on the subject have been carefully read and noted in our records. We hope that our files are complete and reasonably accurate, but over a long period of time there may have been recording errors or missing reports.

For this reason, you will find with this letter a list from our records of concerns reported either to be dealing with other sources of equipment and materials, or to have done so in the past.

We would like this list to be carefully examined and checked with information available in the district files.

Kindly return one copy with your up-to-date corrections or additions. Do you think all reasonable efforts have been made that should have been made with those concerns that have not already seen the advantages of working under our normal arrangements as licensees?

Very truly yours, F. G. Outcalt.

ASP/pg.
Enclosures.

[fol. 1402] DEFENDANTS' EXHIBIT 98-T

The Linde Air Products Co.

File: Corres. Dis. & Div.

New York, N. Y.
January 20, 1941.

To: All Unionmelt Field Engineers, All Unionmelt Service Operators, All Division Sales Managers, All District Sales Managers, All Process Service Managers.

Subject: Unionmelt Welding Process.

GENTLEMEN:

During the last year the Unionmelt Welding Process has become firmly established in many nationally known manufacturers' plants, and the prospects for further expansion and application seem to be a long way from being exhausted. Although there are many manufacturers' plants and many branches of the steel fabricating industry which have not yet taken up Unionmelt in a large way, we expect that before this year is over many new lines of industry will be opened up for the process.

In addition to the above mentioned expansion we feel that there are a large number of applications in the plants of present licensees which might be adaptable to Unionmelt welding and which would substantially increase the use of the process and consequently the installation of new welding equipment and consumption of materials. We feel that with the present large volume of business in the steel fabricating industry and the very wide program ahead in connection with the government rearmament program, many opportunities will reveal themselves if we make a point of keeping a close watch on all the operations in our licensees' plants.

We would particularly ask all field men having any contact whatever with Unionmelt activities to make a point of spending as much time in the plants of licensees as possible and using any reasonable means whatever to become familiar with the future type of structures coming into these plants. We feel quite sure that if our field men can be informed ahead of time of these new undertakings that many of them can be adapted to our process. To accomplish this, of course, will require the spending of more time in these plants and becoming more familiar with the managements, probably more so than has been practiced in the past. For these reasons we would ask you to arrange your contacts in the future that you will be able to extend the application of the Unionmelt process in the plants of licensees more than has been done in the past.

We have noticed in the last several months that large employers of welders have commented upon the great scarcity in the supply of experienced welders. In shipbuilding particularly it would seem that with the great amount of welding which is in the offing, contractors will not be able to secure a supply of men for the large amounts of welding which are to be done. The only answer would seem to be a reliable automatic welding process and on this one point at least you will probably be able to capitalize and push the sale of the Unionmelt welding process. Another feature which may be of use to you in the future is the Unionmelt hand welding equipment which is now approaching the final development stage. One of the car building plants is using two of our hand welders quite successfully and we feel that other applications could be readily found if properly introduced to the different plants of licensees.

[fol. 1493] We feel that the amount of development that has taken place in the past and the much less attention that is now needed in the case of fabricators who are well established in the process that you can devote more time to new applications than previously. We should indeed be pleased to hear of your embarking more vigorously upon such a program and to know of any scheme which you are following in order to bring about this expansion of the process. We realize, of course, that each plant and each man's problems may be of a different character but we confidently

believe that all of these plants can use the process to a larger extent than is being done at the present time.

Very truly yours, J. M. Keir.

JMK:RJ.

[fol. 1404] DEFENDANTS' EXHIBIT 98-U

The Linde Air Products Company

New York City.
August 15, 1941.

All Unionmelt Department Men.

Copies: Messrs. L. D. Burnett, W. A. Duncan, L. B. Ely, F. C. Hasse, F. C. Hutchison, Jean La Force, G. D. Stone, W. S. Walker, W. H. Wharton.

Aug. 28, 1941

Unionmelt Welding Process

Priorities for Defense Supplies

GENTLEMEN:

For the benefit of those who have not received General Sales Office Memorandum dated July 30 signed by Mr. L. D. Burnett, explaining the Defense Rating Plan under which the Oxweld Acetylene Company's manufacturing will be carried on in the future, and because Unionmelt products were specifically excluded from the materials covered by that Memorandum, this letter will briefly restate those portions of the Memorandum which are applicable to equipment and materials for use with the Unionmelt process. The entire Linde sales organization will be notified thru regular channels.

You realize that most of the raw materials used in manufacturing Unionmelt equipment are "Scarce Materials" which cannot now be secured without priority ratings. Under the "Defense Supplies Rating Plan," which is the plan deemed most suitable for operation of the Oxweld Acetylene manufacturing plant, materials for production of equipment for future sales will be made available on the basis of future estimated requirements of Defense Supplies as justified by requirements of the past. In study-

ing our past orders to justify estimated requirements of Unionmelt equipment for the three-month period beginning August 1, we have found that practically all Unionmelt equipment and parts ordered during the three-months period ending July 31 could be classed as "Defense Supplies." We rather expect this tendency to continue and do not expect many orders will be tendered to us which are not for "Defense Supplies." The term "Defense Supplies" is defined in the copy of "Customer's Affidavit of Defense Requirements," which is attached to this letter and you should become familiar with this definition.

Beginning immediately, all orders for Unionmelt equipment and parts should show on the face of the order that the equipment or parts are "Defense Supplies." We do not expect to be able to furnish equipment except when so classified and accompanied by supporting evidence as noted below.

Although there is immediate need to relate only Unionmelt *equipment* to Defense, we may require similar justification for rod and melt in the future, and beginning immediately all customers orders for Unionmelt and welding [fol. 1405] rod for Unionmelt welding should show on the face of the order whether or not the materials required are "Defense Supplies." All materials and equipment classified as "Defense Supplies" should be identified with:

(a) the number of the Defense Contract or Subcontract or Project on which the materials are to be used and the rating.

(b) the number of the Preference Rating Certificate and rating for the work on which our materials are to be used (Actual Certificate not needed).

(c) "Customers Affidavit of Defense Requirements" which should be used only when (a) or (b) are not available.

When necessary for our Customer to use the "Customers Affidavit of Defense Requirements," a separate Affidavit should be made for each order or group of orders given us at any one time. One affidavit should not be made for orders to be sent at some later time, but one Affidavit should cover only those orders to which it can be physically attached. Affidavits covering orders for rod and melt, when less than 100% of the materials may be for defense work,

should be separate from Affidavits covering equipment even though both items may be included on a single customers. order.

Beginning immediately, all customers' orders for Unionmelt, Unionmelt equipment, and rod and any accompanying affivavits or other "Defense Supplies" classification supporting papers should be sent with the usual three copies of form 1205-R to the Unionmelt Department in New York so that the original authority from the customer for classifying his materials as "Defense Supplies" may be kept in the Unionmelt Department order files. The District Offices when making out the Unionmelt Department Requisition, form 1205-R, should note on all copies full information taken from the customer's order so that recipients of each copy will have proper indication of the Defense status of the materials ordered.

At present, we see no reason why we should not be able to fill rod and Unionmelt orders whether or not they are for "Defense Supplies"; but since the situation may change, we desire that orders for these materials as well as orders for equipment indicate whether the materials ordered are either all or in part "Defense Supplies" and give information supporting the "Defense" classification.

Very truly yours, F. G. Outcalt.

F. G. Outcalt/wm.

[fol. 1406] LAP 1265-R

Customers' Affidavit of Defense Requirements

STATE OF ——,
County of ——, ss:

The undersigned being duly sworn deposes and says that

1. This affidavit is made on behalf of and by authority of ——————————;
(Official Name of Customer)

2. The facts herein set forth are, to the best of his knowledge and belief, true and correct;

3. Our Order No. ——, placed with The Linde Air Products Company constitutes —— per cent Defense Supplies as defined below:

Definition of Defense Supplies:

The material, parts and assemblies entering directly or indirectly at any stage of production into material for delivery under any contracts or orders.

(a) placed by the Army or Navy, or

(b) for the defense of Great Britain, or

(c) for the Government of any other country whose defense the President deems vital to the defense of the United States, or

(d) for the account of the following agencies of the United States Government: The Coast Guard, Maritime Commission, Coast and Geodetic Survey, Panama Canal, National Advisory Committee on Aeronautics, and the Civil Aeronautics Administration, or

(e) Carrying a preference rating of A-1-a to A-10 inclusive;

also, for any material, parts or assemblies to be used in the manufacture or processing thereof.

_____

(Signature)

Sworn to and subscribed before me this —— day of ——, 19—. —— ——, Notary Public. My Commission expires: —— —, ——.

[fol. 1407] DEFENDANTS' EXHIBIT 98-V

The Linde Air Products Company

New York, September 4, 1941.

All Unionmelt Department Field Men.
Copies: All District Offices.

Unionmelt Welding Process, Priorities for Defense Supplies

You already have instructions about the necessity for having all orders for Unionmelt equipment and when possible all orders for rod and Unionmelt classified as Defense

Supplies and accompanied by the necessary supporting evidence. In the future all quotations for equipment should include the following paragraph:

"Because of operation of our plant under the Defense Supplies Rating Plan, orders should state that the materials required are "Defense Supplies" and should show as supporting evidence:

"(a) the number of the Defense Contract or Subcontract or Project on which the materials are to be used and the rating; or

"(b) the number of the Preference Rating Certificate and rating for the work on which our materials are to be used (extension of preference rating optional); or

"(c) "Customer's Affidavit of Defense Requirements" which should be used only when (a) or (b) are not available."

At present, although orders for Unionmelt and rod do not absolutely require "Defense Supplies Rating", they should be so classed wherever possible and the customer's orders should be accompanied by supporting information.

Very truly yours, F. G. Outcalt.

F. G. Outcalt:S

Copies of (c) are obtainable in the District Offices.

[fol. 1408] DEFENDANTS' EXHIBIT 98-W

The Linde Air Products Co., New York

September 17, 1941.

All District Offices.
All Div. Sales Offices.
All Division Accountants.
All Unionmelt Dept. Field Men.

Defense Supplies Rating Plan

Unionmelt Welding Process

GENTLEMEN:

With this letter is a copy of a letter of August 15 (mailed August 28) regarding the procedure of handling orders for Unionmelt equipment and materials under requirements of the Defense Supplies Rating Plan.

The copy of Customer's Affidavit of Defense Requirements Form 1265-R which accompanied the original mailing of this letter has been detached since as stated in Mr. L. D. Burnett's letter of September 12, it is superceded by PD-25C revised 8-15-41 and PD-25d.

Your attention is particularly called to the next to the last paragraph in the letter of August 15 which states that all customers' orders for Unionmelt equipment and material and any accompanying supporting papers for the Defense Supplies classification should be sent with the usual three copies of Unionmelt Material Requisition Form 1205-R, to the Unionmelt Department in New York. All orders have in the past been retained in the District Offices.

Although the above-mentioned paragraph stated that the orders would be held in the Unionmelt Department files in New York, it has since been decided that orders and original "Defense Supplies" supporting papers will be sent by the Unionmelt Department to the Division Accounting Offices with the Division Accounting Office Form 1205-R.

[fol. 1409] Because the letter regarding Unionmelt orders was delayed until all details of the Defense Supplies Rating Plan were cleared through Washington, it now becomes necessary to ask each District Office to collect all original Unionmelt orders received from customers during August as well as those received during this month and send them to the Unionmelt Department in New York. Before sending these orders to New York, any which do not show that the equipment and materials ordered are Defense Supplies should be checked with the customer in an effort to learn whether the materials can be classed as Defense Supplies. The District Office should make a notation on each order stating whether the equipment and materials are or are not Defense Supplies and giving one of the three identifications mentioned in the letter of August 15 as evidence of Defense classification.

With the copy of this letter going to Unionmelt Department men is a copy of Mr. Burnett's letter of September 12, much of which is applicable to Unionmelt equipment and materials.

Very truly yours, F. G. Outcalt.

F G Outcalt/wm.

[fol. 1410] DEFENDANTS' EXHIBIT 98-X

This letter has been sent to all Unionmelt licensees of the Linde Company.

All District Sales Managers (2).
All Division Sales Managers.
All Division Service Managers.
All Division Accountants.
Mr. G. T. Bogert.
Mr. E. C. Hasse.
Mr. D. S. Lloyd.
Mr. J. R. Lotz.
Mr. T. C. Manton, Jr.
Mr. L. E. Ogden.
Mr. F. A. Potts.

January 9, 1942. File—CDD.

During the quarter-yearly period ending December 31, 1941, the average of the composite price of finished steel as published in The Iron Age remained unchanged from that of the previous quarter. Therefore, in accordance with the policy established in our letter of October 8, 1941, there will be no change in prices of Unionmelt welding composition, Unionmelt welding heads, and Unionmelt process license fee rates for the first quarter of 1942 even though, as shown on the sheet accompanying this letter, the composite price exceeds the "base" composite price by 1.09 units of 10% of the "base."

In our last quarterly price letter notice was given of a change in drum size for shipments of Unionmelt welding composition. Further change is now being considered and during the next three months shipments may perhaps be made not only in 350- to 400-pound capacity steel drums and 200-pound capacity steel drums, but also in heavy paper bags somewhat similar to those which have so long been standard for the packaging of portland cement. These bags will contain 100 pounds of Unionmelt. The use of paper bags will help conserve steel and should also facilitate handling of the materials both in transit and in user's plants.

This future change makes even more important our request that Unionmelt be ordered by weight instead of by number of containers. We will ordinarily fill orders as closely as practical by shipping full containers. Both order-

ing and receiving departments should note the possibility of this further change in Unionmelt packaging.

During the past few months an improvement has been made in the CM-21U Carriage frequently used as part of the assemblies including the Type U and Type S welding heads. A speedometer added to the unit gives visual indication at all times of the speed of travel and provides for more accurate speed adjustment. This improvement has raised the manufacturing cost, part of which extra cost is being added to the price of the carriage, which will be $25 higher than the former price. This carriage is of course not included in the price of welding heads specified in the Unionmelt process license agreement, which prices remain at "base."

Very truly yours, F. G. Outcalt.

New price sheets for welding heads and attachments for the first quarter of 1942 accompany this letter. Old ones should be destroyed and outstanding quotations involving the CM-21U carriage should be revised.

[fol. 1411] DEFENDANTS' EXHIBIT 98-Y

The Linde Air Products Company

New York, New York
May 28, 1942. CDD.

To: All Unionmelt Field Engineers.
All Unionmelt Service Operators.
All Process Service Managers.
All Division Sales Managers.
All District Sales Offices.
Dominion Oxygen Company, Ltd.
Oxweld Railroad Service Company.

GENTLEMEN:

You now have in your possession a copy of our mimeographed booklet "Unionmelt Welding Process as Applied to Ship Construction" dated March 20, 1940. This booklet at the time of its issue represented the best known practice in ship welding with Unionmelt.

Since the period of the original issue, a substantial amount of development has taken place and considerable improve-

ment in general technique has been worked out. It has accordingly been deemed proper to bring this booklet up to date in keeping with the latest practice, and we are pleased to send you herewith one copy of the new edition, which we hope will be found useful.

We would like to point out that while the descriptive matter is aimed directly to ship welding, it will be found, nevertheless, to be applicable to various types of construction where similar joints may be used, and we hope that field men in general will find new applications where similar joints are encountered.

Unionmelt Department, J. M. Keir.

JMK/eb.
Enclosure: Ship Manual.

[fol. 1412] DEFENDANTS' EXHIBIT 104-A

The Lincoln Electric Company

Shield-Arc Welders . Fleetweld Electrodes

Line-Weld Motors . Welding Supplies

12818 Coit Road

Cleveland, Ohio

Date July 31, 1941.

In reply, refer to J. F. Lincoln.

Mr. R. E. Cornwell,
Room 607,
30 East 42nd St.,
New York, N. Y.

MY DEAR MR. CORNWELL:

Since I saw you last in New York, I have been going through the patent situation very carefully.

I would refer you to Patent #1,589,017 taken out by Mr. John C. Lincoln, which has for some time been the property of the Lincoln Electric Company. I would refer you to the first claim which I am quoting:

"The method of arc welding, which consists in surrounding the molten metal with an inert medium during the welding operations, substantially as set forth."

I am also referring you to claim sixteen which reads:

"The method of welding, which consists in opposing unprepared edges of the sheets to be united, supplying an independent body of metal thereto, providing a slag covering for said opposing edges, and causing a heating flame to travel along said edges, substantially as set forth."

I wish you would at least glance over this patent (copy of which I am enclosing), as I believe you will find the following:

1. That the Unionmelt process infringes this patent, and please note that the application for this patent was made in 1918, long before any Unionmelt process had been suggested.
2. That this patent also covers welding with any inert slag or gas that may be used in welding.

[fol. 1412a] The reputation of your good company has always been that you respect patents held by other concerns and I am sure in this particular case that you have inadvertently overlooked this particular patent.

We, ourselves, only recently have had an opportunity to see one of the Unionmelt operations and to have done sufficient work in our laboratory on it to have arrived at the conclusion that the Unionmelt operation is in exact accordance, in our opinion, with the claims of this patent.

My personal contact with you has been such that I am approaching you regarding this informally rather than in the formal method which is frequently used in notifications of this kind. It may be that you would wish to discuss this matter with me and I should be very glad indeed to discuss it with you. I should be glad to go over the matter with you here in Cleveland, or in New York, or any other point which would be mutually satisfactory.

May I add one more point in connection with any such conference if it is to take place—I am under the impression that while you are the moving spirit in connection with the development of this Unionmelt process you are not the

policy-determining individual for your company on matters of this kind. If that is true might I request that in case a conference is arranged for that such a policy-determining individual may take part in the conference so that a conclusion can be arranged at that time?

Again let me assure you that we are approaching this matter in a most friendly attitude of mind and that we are very anxious to find a fair solution to the situation.

May I hear from you at your early convenience.

Kindest personal regards.

Yours very truly,

The Lincoln Electric Company: J. F. Lincoln, President.

JFL-LL

[fol. 1413] P.S.—I might also suggest to you the review of Patent #1,827,245 issued to this Company, application having been made in March, 1922, issue of the patent October 13, 1931. I would like to suggest your glancing through the whole patent but direct your attention particularly to the following generic claim:

> "In an electrode-holder for arc-welding mechanism, the combination of a body-member, a chuck reciprocably mounted in said body-member and adapted to grip an electrode, and a conductor member attached to said body member, said conductor member extending parallel with the electrode and having an offset portion formed with an aperture adapted slidably to embrace the electrode close to the working end thereof."
>
> J. F. Lincoln.

DEFENDANT'S EXHIBIT

~~DEFENDANT'S EXHIBIT~~

DEFENDANTS' EXHIBIT 142

UNITED STATES PATENT OFFICE.

EDWARD A. WHITCOMB, OF CINCINNATI, OHIO.

WELDING-FLUX.

SPECIFICATION forming part of Letters Patent No. 277,393, dated May 8, 1883.

Application filed February 16, 1883. (No specimens.)

To all whom it may concern:

Be it known that I, EDWARD A. WHITCOMB, a citizen of the United States, and a resident of Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Welding-Flux, of which the following is a specification.

My invention relates to a new flux adapted to clean and promote the uniting of metals by welding, brazing, or soldering.

One object of my invention is to provide a compound or flux which will, as a reagent, cause a ready welding or brazing of the hardest steel; also to provide a substance which will produce a much stronger union of pieces of metal when used to prepare them for welding or brazing.

The following is the preferred formula for preparing my compound: Take fluor-spar one hundred parts, by weight, finely pulverized, and four pounds of soda-alum freed from its water of crystallization, finely pulverized, and mix the two powders thoroughly. Fluor-spar usually contains silica, which is essential in my compound. An excess of silica does no harm, and I prefer to add ten parts of silica, finely powdered, to the compound. So, also, soda-alum of commerce usually contains impurities, and to neutralize such impurities and prevent the generation of deleterious gases I add two parts of pulverized borax; but if the fluor-spar contains ten per cent. of silica, and the alum be chemically pure and the water of crystallization be driven off, the compound is adapted to be used in the usual manner, by placing it on the parts to be brazed or welded in the manner usually employed with other substances now used for like purposes.

I have found my compound to be superior to any other fluor acids or salts hitherto used in brazing or welding metal.

The proportions here stated are believed to be the best; but they can be varied to a considerable degree without seriously impairing its efficiency. Other alums could be used but they are inferior to soda-alum.

I claim—

EDWARD A. WHITCOMB, OF CINCINNATI, OHIO.

WELDING-FLUX.

SPECIFICATION forming part of Letters Patent No. 277,393, dated May 8, 1883.

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To all whom it may concern:

Be it known that I, EDWARD A. WHITCOMB, a citizen of the United States, and a resident of Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Welding-Flux, of which the following is a specification.

My invention relates to a new flux adapted to clean and promote the uniting of metals by welding, brazing, or soldering.

One object of my invention is to provide a compound or flux which will, as a reagent, cause a ready welding or brazing of the hardest steel; also to provide a substance which will produce a much stronger union of pieces of metal when used to prepare them for welding or brazing.

The following is the preferred formula for preparing my compound: Take fluor-spar one hundred parts, by weight, finely pulverized, and four pounds of soda-alum freed from its water of crystallization, finely pulverized, and mix the two powders thoroughly. Fluor-spar usually contains silica, which is essential in my compound. An excess of silica does no harm, and I prefer to add ten parts of silica, finely powdered, to the compound. So, also, soda-alum of commerce usually contains impurities, and to neutralize such impurities and prevent the generation of deleterious gases I add two parts of pulverized borax; but if the fluor-spar contains ten per cent. of silica, and the alum be chemically pure and the water of crystallization be driven off, the compound is adapted to be used in the usual manner, by placing it on the parts to be brazed or welded in the manner usually employed with other substances now used for like purposes.

I have found my compound to be superior to any other fluor acids or salts hitherto used in brazing or welding metal.

The proportions here stated are believed to be the best; but they can be varied to a considerable degree without seriously impairing its efficiency. Other alums could be used but they are inferior to soda-alum.

I claim—

1. As a new article of manufacture, a flux composed of fluor-spar and alum mechanically mixed, substantially as herein set forth.

2. Flux composed of fluor-spar, silica, and alum mechanically mixed, substantially as herein set forth.

3. A flux composed of fluor spar, silica, alum, and borax, mechanically mixed, substantially as herein set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

EDWARD A. WHITCOMB.

Witnesses:

JNO. E. JONES,

A. GLUCHOWSKY.

UNITED STATES PATENT OFFICE.

CECIL C. ROBERTS, OF MOUNT VERNON, OHIO.

WELDING COMPOUND.

1,283,909. Specification of Letters Patent. Patented Nov. 5, 1918.

No Drawing. Application filed August 15, 1916. Serial No. 115,008.

To all whom it may concern:

Be it known that I, CECIL C. ROBERTS, a citizen of the United States, residing at Mount Vernon, in the county of Knox and State of Ohio, have invented certain new and useful Improvements in Welding Compounds, of which the following is a specification.

This invention has relation to chemical compounds and mixtures for use in promoting the joining of metallic parts in welding processes, soldering or the like, said compound depending upon the property of dissolving the oxids which form on the surface of the parts when heated, as a scale, and which, if not removed destroys the cohesion of the parts thereby preventing the formation of a rigid joint.

Another object of the invention is to provide a compound of the character and for the purpose set forth, which contains in addition to usual substances for dissolving the metallic oxids, a certain proportion of a natural aluminum containing mineral.

In addition to the foregoing, my invention comprehends the proportion of ingredients to be hereinafter described and more particularly set forth in the appended claim.

Before proceeding with a detailed description of the compound and the manner of its use, attention is directed to the fact that while this compound is intended primarily and particularly for welding or joining iron and steel parts, nevertheless the welding of other metals may be accomplished with various degrees of success. A certain proportion of finely divided iron is employed in the compound when the same is to be used for welding iron or steel, and if the compound is to be used in joining or brazing copper or the like, it is obvious that a certain proportion of that metal in a finely divided state may be substituted for the iron.

It has been my experience that the most satisfactory results from the use of my compound are obtained when the ingredients are combined in the following proportions:

Iron (or steel) filings	20 parts
Sand	50 parts
Powdered glass	5 parts
Cryolite	10 parts
Borax (calcined)	15 parts

These materials are first reduced to a fine or pulverized condition, and subsequently mixed in the proportions named.

The sand employed is preferably of the character known as "glass sand" as the same is practically pure silica. The borax before pulverizing should first be calcined so as to expel its water of crystallization; and I have found by experience that the commercial variety of borax is more adapted and is productive of the best results in the use of my compound than the more purified variety. This is due to the fact that the borax contains in addition small proportions of oxid of iron, aluminum, and calcium, which facilitates the action of the compound in a manner to be presently obvious.

To those familiar with the art to which this invention appertains, its use will be quite obvious, it may be stated however, that the parts to be joined are heated to the desired temperature and the compound sprinkled thereover before joining the parts by forging or otherwise. The action of this compound as in compounds of a similar nature is to dissolve the metallic oxids which are formed on the heated parts, and which oxids if not removed would form a scale separating the meeting surfaces and thereby preventing the formation of a firm and rigid joint. The compound therefore acts as a flux. Sand and borax are the agents whereby the oxids are dissolved and the glass is used to reduce the fluidity of the metal or to prevent the same from running.

The present invention however, comprehends in addition to providing the usual fluxing agents, the provision of a natural mineral compound of aluminum such as cryolite, fluorite, or other combinations of aluminum and fluorin. Other compounds of aluminum with acids other than fluorin may be employed without departing from the spirit of the invention.

While I have set forth with some degree of particularity stating the exact ingredients of this compound, and the specific manner of its combination in the proportions given, I nevertheless realize that alterations in the proportions may be made, and I therefore reserve the right and privilege of substituting ingredients in the compound of similar nature, or otherwise altering the proportions of the ingredients as hereinbefore given,

without departing from the spirit of the invention or the scope of the appended claim.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

A welding compound which includes finely divided iron in the proportion of twenty parts thereof, fifty parts of sand, five parts of glass, ten parts of cryolite, and fifteen parts of calcined borax, thoroughly 1(mixed together.

In testimony whereof I affix my signature in presence of two witnesses.

CECIL C. ROBERTS.

Witnesses:
JEANNETTE SAPP,
B. E. SAPP.

DEFENDANTS' EXHIBIT 143

No. 721,703. PATENTED MAR. 3, 1903.

P. L. T. HÉROULT.

ELECTRIC FURNACE.

APPLICATION FILED OCT. 11, 1900.

NO MODEL.

FIG. 1.

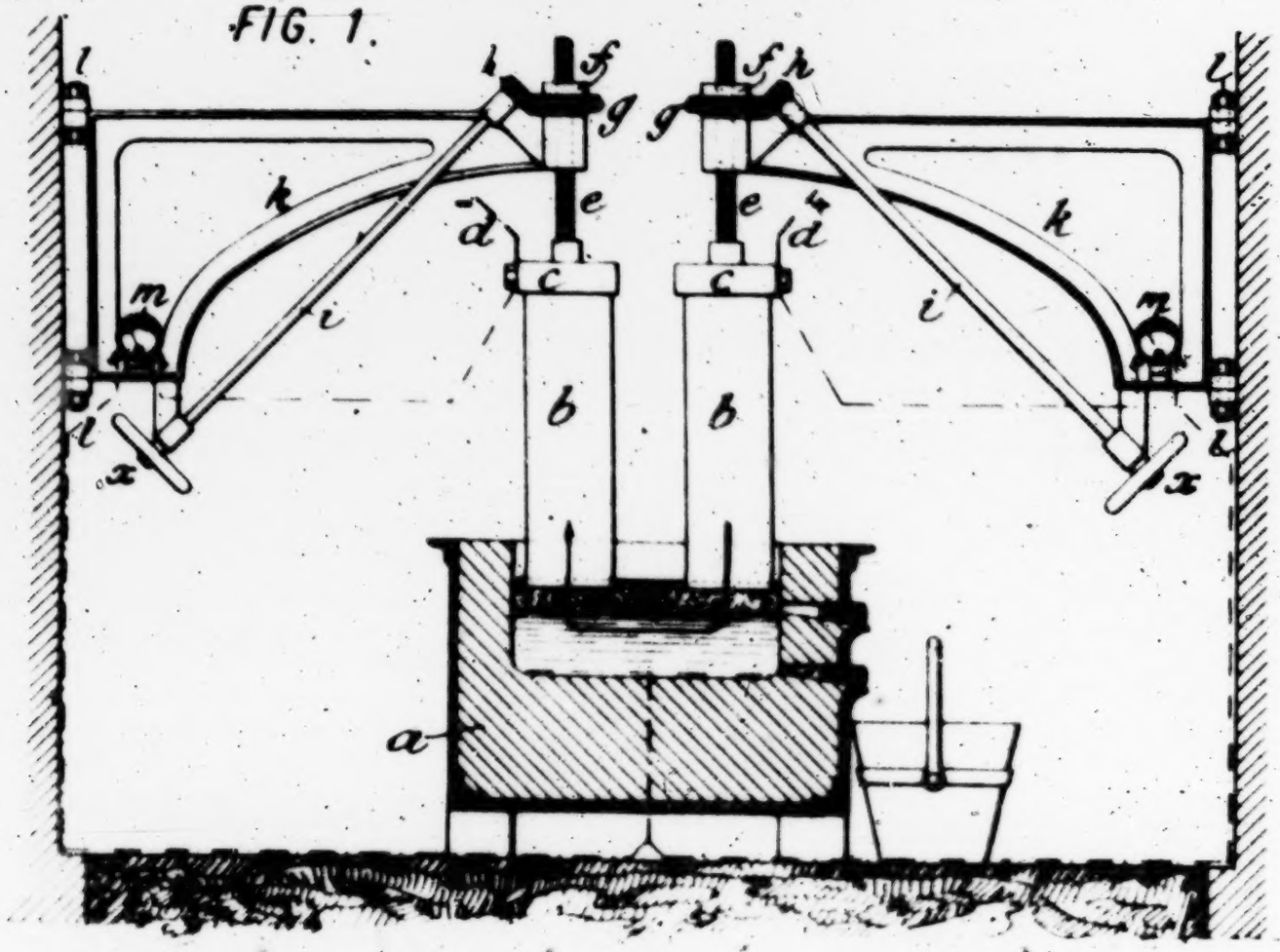
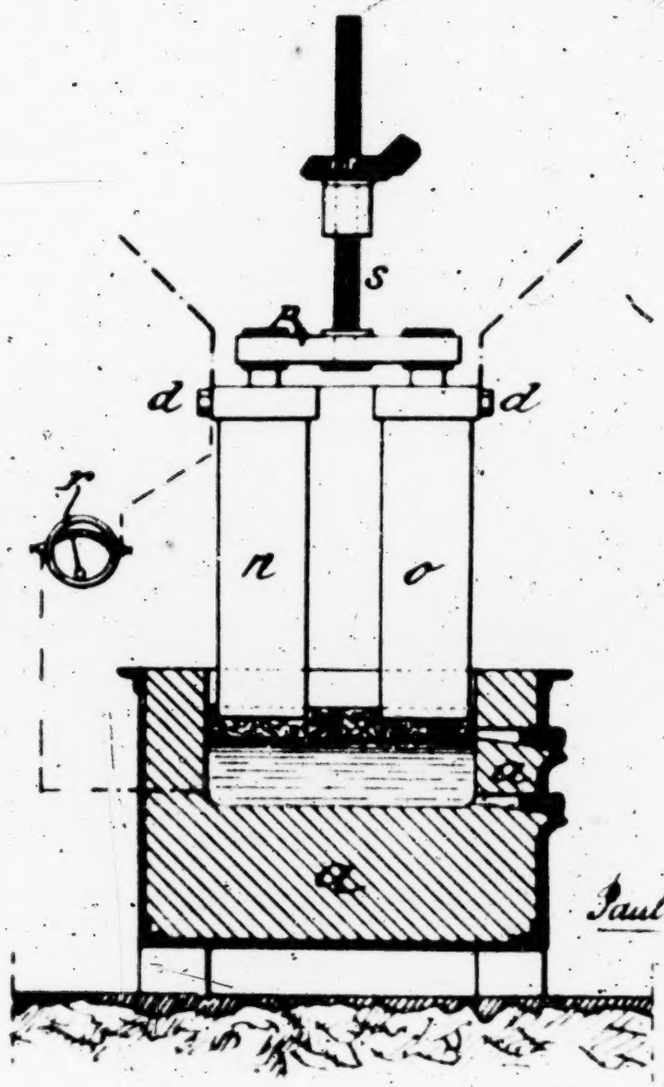


FIG 2

FIG. 2



WITNESSES

Fred Whitehead

Thomas Wallace

INVENTOR

Paul Louis Toussaint Héroult,

By his Attorneys

Wilkinson, Mason & Co

1417

1888

(1320) 1419

cut off the operation of the furnace, but would damage the electrodes.

The arrangement described is applicable not only to the reduction of ores, but also to the decarburization of substances treated with oxidizing slags or with air-blast, and it may be combined with any arrangement for using gases evolved from the reducing action in the crucible, so as to subject the substances to be treated to preliminary heating or reduction.

When the arrangement is applied to the manufacture of steel or melted iron, there is directly obtained in the crucible metal decarburized by the slag, and the reducing gases in passing through the soft ore between the electrodes so act that the ore is partly reduced before undergoing electrical fusion. Cast-iron can also be decarbureted or dephosphorated by the use of reagents according to the Thomas process.

The slag which forms the resisting medium in which the heat is produced may be of various compositions. For example, when the furnace is used for the production of metals the slag is mostly imperfectly-reduced mineral matter, or if the furnace be used to obtain stability of composition of mixtures of fine steel with other elements—such as chromium, nickel, tungsten, &c.—the slag is composed chiefly of reagents designed to act on the bath of metal—such as lime, dolomite, or oxid of iron liquefied by the addition of silica—or it may be substantially neutral, such as a fusible silicate which has no chemical action on the bath.

The voltmeter-terminal which communicates with the material in the crucible is preferably a rod of the same metal as that being produced in the crucible and is built into or passes through the refractory wall of the crucible into the material within the same. When the rod melts, the space or hole which it leaves in the wall is filled with molten conducting material, the extent of fusion of which is limited by the proximity of the cold exterior wall. As the current carried by this terminal is only a few milliamperes, this arrangement works very well.

I am aware that there are already in use electric furnaces having two electrodes of the Cowles kind; but in these furnaces, which are generally inclosed in non-conducting materials, it is only by accident that the main arc subdivides into several partial arcs. This may also happen in furnaces in which the arc plays on the treated substance or is blown upon it by a magnet. I am also aware that there are furnaces with multiple electrodes producing several arcs playing above the material treated and heating by radiation and not by passing through it.

I claim—

In an electric furnace, the combination of a crucible adapted to carry a bath of molten material, two electrodes supported above it and connected in series, a conductor in position to effect contact with material contained in the crucible and a voltmeter in shunt between one of said electrodes and said conductor, said conductor consisting of a rod passing through the refractory material of the crucible and projecting outside and inside of the same whereby the portion of the rod which is melted is replaced by molten material which fills up the space and thus insures good conductivity.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

PAUL LOUIS TOUSSAINT HEROULT.

Witnesses:

JULES ARMENGAUD, Jeune,

EDWARD P. MACLEAN.

UNITED STATES PATENT OFFICE.

PAUL LOUIS TOUSSAINT HEROULT, OF LA PRAZ, FRANCE, ASSIGNOR TO STE ELECTRO METALLURGIQUE FRANCAISE, OF FROGES, ISÈRE, FRANCE.

ELECTRIC FURNACE.

SPECIFICATION forming part of Letters Patent No. 721,703, dated March 3, 1903.

Application filed October 11, 1900. Serial No. 32,667. (No model.)

To all whom it may concern:

Be it known that I, PAUL LOUIS TOUSSAINT HÉROULT, a citizen of the Republic of France, residing in La Praz, Savoie, France, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification.

The improvements to which this invention relates have been devised in order to obtain by the electric furnace soft metals, such as chromium, manganese, or iron, and generally substances which tend to combine with carbon. In order to avoid as much as possible all possible introduction into the material operated on of carbon from the electrodes instead of the single arc which usually heats an electric furnace, two separate arcs in series are, according to this invention, employed to play through the insulating layer of slag between the metal or the fused conducting material on the one hand and the two electrodes on the other hand. In order to insure the distinct formation of these two arcs, two accessory circuits are arranged, connecting outside the furnace each of the two electrodes to the fused material, and in each of these circuits there is introduced in shunt a voltmeter, the indications of which serve to constantly verify and regulate the position of both electrodes and to determine whether or not the furnace is operating properly. Thus either by hand or by automatic mechanism operated by the two shunt-currents each electrode can be raised or lowered to determine the arc, as desired. The outgoing conductor consists of a rod passing through the crucible-wall and projecting outside and inside of the same, so that the portion of the rod which is melted is replaced by molten material which fills up the space and insures good conductivity. When alternating currents are employed and the electrodes are arranged so as to consume equally, the position of both can be regulated at the same time by employing a single voltmeter between one of the electrodes and the metal.

Such is the principle of the invention which is carried out as will be described referring to the accompanying drawings.

Figure 1 is an elevation, partly sectional, arranged as described in the first place for use with currents either continuous or alternating. Fig. 2 shows the same furnace adapted solely to alternating currents.

The crucible *a* is made of suitable refractory material—such as fire-brick, magnesia, dolomite, lime, silica, chromite, or the like—and it is inclosed in an iron casing. Such a crucible is usually provided with two tap-holes at different levels, the one for running out metal, the other for running out slag or the like. In the crucible is placed the material to be treated, above which the two electrodes *b b* are carried in sockets *c c*, having current connections *d d* and long screw-threaded rods *e e*, which pass through nuts *f f*, consisting of the bosses of bevel-wheels *g g*, gearing with pinions *h h* on spindles *i i*, that can be turned by hand-wheels *x x*. Each of the electrodes and the parts belonging to it are carried by a cantaliver-frame *k*, which is hinged at *l*, so that it can be turned aside from over the furnace. A voltmeter *m* is introduced in shunt between each electrode and the molten metal, and these show how the operation proceeds, so that according to these indications the attendant can raise or lower either electrode, so as to regulate each of the arcs.

In Fig. 2 the two electrodes *n o* are shown to be carried by an insulated cross-head *p*, each having its current connection.

A voltmeter *r* is introduced in a shunt-circuit between one of the electrodes and the molten metal. This indicates variations of tension, so that the distance between the electrodes and the bath of metal can be varied, as required, by raising or lowering the screwed rod *s*, which carries the electrode and is worked in the same way as was described with reference to Fig. 1. Obviously such an arrangement could be employed with triphase or polyphase currents by providing more than two electrodes with the means described of regulating their positions.

The arrangement of the voltmeter between the electrodes and the molten material, while the electrodes themselves are in series with each other, serves to indicate at once and without the necessity of direct inspection the occurrence of a short circuit between the electrodes, an occurrence which would not only

Patented Mar. 31, 1925. 1,532,052

UNITED STATES PATENT OFFICE.

ALBERT E. GREENE, OF CHICAGO, ILLINOIS, ASSIGNOR TO AMERICAN ELECTRIC SMELTING AND ENGINEERING COMPANY, OF ST. LOUIS, MISSOURI, A CORPORATION OF MISSOURI.

TREATMENT OF IRON OR STEEL IN ELECTRIC FURNACES.

Application filed January 2, 1909. Serial No. 470,366.

To all whom it may concern:

Be it known that I, ALBERT E. GREENE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in the Treatment of Iron or Steel in Electric Furnaces, of which the following is a full, clear, concise, and exact description.

My present invention relates to improvements in metallurgical processes and more particularly to the treatment of iron or steel in electric furnaces. The invention has for its object the provision of an improved electric furnace process for treating iron or steel in the course of which impurities, such as sulfur, phosphorous and oxygen, are removed therefrom, principally as a slag, either singly or together, and in such manner as to leave the iron or steel in a purified and deoxidized condition.

In the making or refining of steel in electric furnaces prior to this invention, the usual method has been to make the lining or hearth of the furnace of basic material, such as burnt magnesite or dolomite, the roof being of silica brick. The slag used has been highly basic, containing—say about 15 per cent of silica, and requiring a considerable addition—say 30 percent of fluorspar to act as a flux. The temperature attainable in the electric furnace is sufficiently high to melt a slag of extreme basicity, and the fumes from the highly basic slags heretofore generally used have a strong corrosive action on the silica of the roof, so that the latter requires renewing at frequent intervals resulting in considerable expense and very serious delays in the operation of the electric furnace. The fluorspar which becomes volatilized has the same corrosive effect on the roof and this material furthermore is quite expensive. The chief reason for using a slag so highly basic has been to reduce to a minimum the sulfur content of the product. I have found, however, that by using a slag containing a comparatively high percentage of silica, the sulfur content of the metal may be reduced to practically the same extent as before and considerable economies are effected in the operating of the furnace and also an improvement secured in the quality of the steel produced.

My invention, accordingly, involves treating iron or steel in a basic electric furnace by applying thereto a slag comprising lime and silica approximately in such proportions as to form a neutral mixture, that is, a mixture that is neither strongly acid nor strongly basic, and maintaining the metal and slag molten under reducing conditions. The actual percentage of silica in the slag will vary considerably for different materials and circumstances, but will generally be between 25 and 35 per cent of the total weight of the slag. Appropriate reducing conditions may be obtained in various ways, as, for example, by the use of suitable carbonaceous reducing agents, such as a gaseous reducing agent acting on the surface of the charge in the furnace. Such reducing conditions, as contemplated by the invention, ensure the reduction of any iron oxide in the slag thereby producing conditions more favorable for the taking up by the slag of phosphorous and sulfur, or either of them.

The essential feature of the improved process of my present invention is the production in a molten bath of iron or steel of conditions favorable for the separation therefrom of phosphorous and sulfur, or either of them, by combination with slag-forming constituents, such as lime and silica, the phosphorous or sulfur compound thus formed floating on top of the molten bath and being removed in the usual manner as a slag. The production of conditions favorable for accomplishing these results is attained by maintaining the molten metal and slag at a temperature at which the phosphorous or sulfur, or both, will combine with the slag-forming constituents present, the quantity of silica present being such that the slag is neither strongly acid nor strongly basic, and by establishing and maintaining suitable reducing conditions.

Thus, the present invention involves regulating, by an electric current, the temperature of a bath of molten iron or steel, covered by a fluid slag comprising lime and silica, and meanwhile acting upon the bath with a reducing agent, such as a carbonaceous gaseous reducing agent, for example, carbon monoxide.

Under such conditions, it appears that the lime in the flux is reduced thereby providing calcium which combines with sulfur to form calcium sulfide, or with phosphorous possibly forming calcium phosphide, respectively. In any event, the combined action of the reducing agent and the fluid lime-silica slag produces conditions favorable for the taking up by the slag of either or both phosphorous and sulfur.

In carrying out the invention, the reducing action and the presence of suitable fluxing agents for forming a fluid lime-silica slag are essential. I have obtained the desired reducing action by blowing a gaseous reducing agent such as carbon monoxide upon the surface of the molten slag covering the molten metal. The necessary reducing action may be obtained in various other ways apparent to those skilled in the art. The carbon of the electrodes in an arc furnace contributes towards the production of the necessary reducing conditions. Without the influence of a reducing action acting on the bath, the separation of phosphorous or sulfur, as contemplated by the invention, is not assured or practicable. It is, however, important that the reducing conditions be controlled. Under the reducing conditions contemplated by my present invention, silica in the slag may be reduced, and the resulting silicon, on account of its high affinity for oxygen, probably materially aids in insuring reducing conditions. At any rate reduction of silica is insurance that reducing conditions have been maintained.

An important feature of the present invention resides in the modification of the heretofore customary highly basic slag by the addition of a relatively high percentage of silica, thereby giving the slag a considerably lower melting point, rendering it more fluid and facilitating its refining action. This feature results in a very material saving in electrical energy over what would be required to melt a straight lime or highly basic slag. I have found, notwithstanding the presence of silica in the slag in sufficient quantity to render it fluid, that the effectiveness of such a slag in removing sulfur from the metal is not substantially lessened and the sulfur may be separated from the steel to practically the same extent as with the heretofore customary highly basic slags. By making the slag fluid by means of silica, in accordance with the present invention, it is possible to pour the slag directly from the furnace instead of having to rake it out as may be necessary with the heretofore customary highly basic slags, or instead of using considerable quantities of fluorspar at an unnecessary expense.

While the process of my invention is not dependent upon the use of any particular type of electric furnace, I have in the accompanying drawings illustrated two types of furnace suitable for practicing the invention. In the drawings—

Fig. 1 is a sectional view of an electric furnace on the line 1—1 of Fig. 2, showing one type of furnace with which my invention may be practiced;

Fig. 2 is a sectional view on the line 2—2 of Fig. 1;

Fig. 3 is a vertical section of an induction furnace with which the process may be practiced; and

Fig. 4 is a plan view of the furnace shown in Fig. 3.

Similar reference characters are used to designate similar parts wherever shown.

Referring to Figs. 1 and 2 the steel casing 1 of the furnace is supported from trunnions 2 and 3, in order that the furnace may be tilted in the usual manner. The side walls 4 are of refractory material and the crucible 5 is provided with a basic lining. The furnace is provided with a removable top 6 of silica or other suitable material.

Electrodes 7 extend through the walls of the furnace and dip into the slag 8. By tilting the furnace the amount of electrode in the slag may be regulated or it can be kept out of the slag. When the electrodes dip in the slag a current of low voltage and high amperage is preferably employed, and the current may be regulated by varying the voltage. Either direct or alternating current may be employed. One electrode may be caused to make contact with the metal 9 where desired. The trunnion 2 is hollow to provide a passage 10 communicating with the tuyère pipe 11. Tuyères 12 extend downward through the wall 4 (see Fig. 2). The reducing gas is introduced under pressure through the passage 10 to the tuyères 12 in any suitable way and at any desirable pressure. The tuyères are inclined downward in order that the gas may come into more thorough contact with the bath. The gas may be blown into the bath or it may be blown into the furnace chamber from above the charge at any suitable place so as to insure contact of the gas with the slag. It is to be noted that the gas entering the highly heated chamber will, if colder than the gas it displaces, spread itself out at the lowest possible level next above the bath by reason of its higher specific gravity than the gas it displaces.

The exhaust gas is preferably let out through the exhaust pipe 13, and such gas may be collected on account of its value.

Figs. 3 and 4 show a well known type of induction furnace. The steel casing thereof may be supported in any suitable manner. The refractory walls 15 enclosed in the casing are annular in shape and surround one leg of the transformer core 16. The core is wound with one or more coils 17.

(p.1332)

which serve as the primary of the transformer, the secondary thereof consisting of the metallic bath 18 contained in the furnace chamber 19. The chamber 19 is provided with a cover, which is preferably made in a plurality of sections 20. Gas is admitted to the furnace chamber 19 from the gas main 21 and the flow thereof is controlled by the valve 22. Tuyeres 23, which are connected by means of pipe 24 with the gas main, extend through the cover 20. The exhaust gasses pass out through the exhaust pipe 25.

In practice, I prefer to use an electric furnace of the types described, or of any other suitable type, for the reason that the fluxes may thereby be readily melted and the temperature of the bath may be regulated and controlled.

Lime is a flux which readily combines with sulfur and under certain conditions with phosphorous. I have found that sulfur may be removed from pig iron to less than 0.005 percent by adding lime to a bath of pig iron, maintaining the metal and slag in a molten condition at a temperature approximately of 1325° C., and by blowing the bath maintained at such temperature with a reducing gas containing 23 percent by volume of carbon monoxide (CO), the remaining content of the gas being non-oxidizing. To maintain the slag fluid at such a low temperature, it is necessary that it contain more than 15 percent of silica.

To remove phosphorous as a slag at such relatively low temperature, it is necessary to have a more fluid slag than is required for sulfur removal. The slag may contain as much as 30 percent of silica and at a temperature of approximately 1400° C., the aforementioned gaseous mixture containing about 23 percent by volume of carbon monoxide (CO) will give a satisfactory elimination of both (or either) phosphorous and sulfur from the iron or steel under treatment.

Slags in certain cases may contain metallic oxides, such as iron oxide, and in the case of Bessemer and open-hearth metal this is invariably the case. After the metal has been treated in the Bessemer converter or the open-hearth furnace, it may be further treated in an electric furnace by the process of this invention, in which case the reducing agent acting upon the molten bath causes the reduction of the iron oxides of the slag, thus recovering the iron and also removing conditions which are detrimental to the removal of sulfur and phosphorous from the metal.

As hereinbefore stated, the reducing agent employed in practicing the improved process of the invention is adapted to act as a reducing agent with respect to the flux (or slag) and incidentally with respect to the metallic oxides of the slag. In the practice of the invention I have secured satisfactory results by the use of carbonaceous gaseous reducing agents. Carbon monoxide is such a gaseous agent. In practice, I have also found that the gases from certain blast furnaces, especially if the gas contains a large amount of carbon monoxide, may be employed, with satisfactory results, to produce in the slag conditions favorable for the removal of phosphorous and sulfur. For example, stack furnace gas, containing 22 percent by volume of carbon monoxide (CO) and 12 percent by volume of carbon dioxide (CO_2), acts in a satisfactory manner as a reducing agent for the flux and accompanying slag in practicing my present invention. Producer gas, which consists largely of carbon monoxide, gases containing a large percentage of hydrogen or methane (CH_4), and the like, may also be used in carrying out the invention.

The process of the invention is of particular advantage in the manufacture of soft or low carbon steel. The greater or less quantity of nascent silicon which enters the bath serves to purify it and in a way to make up in purifying effect for the lack of carbon in the bath. The silica in the slag may be so proportioned that the quantity of nascent silicon which enters the bath shall be only sufficient to have a purifying effect and shall not be sufficient to leave any appreciable percentage of silicon in the finished product.

I claim:

1. The method of treating iron or steel which consist in applying thereto a slag comprising lime and silica and maintaining the metal and slag molten on a basic hearth in an electric furnace, the quantity of silica being about 25 to 35 percent. of the total weight of the slag.

2. The method of treating iron or steel which consists in applying thereto a slag comprising lime and silica and maintaining the metal and slag molten on a basic hearth in an electric furnace, the lime and silica being approximately in such proportions as to form a neutral mixture, that is, a mixture which is neither strongly acid nor strongly basic.

3. The method of treating iron or steel which consists in applying thereto a slag comprising lime and silica and maintaining the metal and slag molten on a basic hearth in an electric furnace, the percentage of silica in the slag being sufficient to practically avoid formation of fumes of lime in the furnace.

4. In the making of soft or low carbon steel the method which consists in applying to the bath a slag comprising lime and silica and maintaining the metal and slag molten on a basic hearth in an electric furnace, the

percentage of silica in the slag being so high that silicon is reduced therefrom and enters the bath in nascent condition.

5. In the making of soft or low carbon steel the method which consists in applying to the bath a slag comprising lime and silica and maintaining the metal and slag molten on a basic hearth in an electric furnace, the percentage of silica in the slag being so high that silicon is reduced therefrom and enters the bath in nascent condition in sufficient quantity to remove impurities to a substantial extent but not in sufficient quantity to appear in an appreciable percentage in the finished product.

6. The method of treating iron or steel which consists in applying thereto a slag comprising lime and silica and maintaining the metal and slag molten on a basic hearth in an electric furnace under reducing conditions, the quantity of silica being about 25 to 35 per cent of the total weight of the slag.

7. The method of treating iron or steel which consists in applying thereto a slag comprising lime and silica and maintaining the metal and slag molten on a basic hearth in an electric furnace under reducing conditions, the lime and silica being approximately in such proportions as to form a neutral mixture, that is, a mixture which is neither strongly acid nor strongly basic.

8. The method of treating iron or steel which consists in applying thereto a slag comprising lime and silica and maintaining the metal and slag molten on a basic hearth in an electric furnace while subjected to the action of a reducing agent, the percentage of silica in the slag being sufficient to practically avoid formation of fumes of lime in the furnace.

9. The method of treating iron or steel which consists in applying thereto a slag comprising lime and silica and maintaining the metal and slag molten on a basic hearth in an electric furnace under reducing conditions, the percentage of silica in the slag being so high that silicon is reduced therefrom and enters the molten bath in nascent condition.

10. The method of treating iron or steel, which consists in applying thereto a slag comprising lime and silica and maintaining the metal and slag molten on a basic hearth in an electric furnace while subjected to the action of a reducing agent, the percentage of silica in the slag being so high that silicon is reduced therefrom and enters the molten bath in nascent condition in sufficient quantity to remove impurities to a substantial extent but not in sufficient quantity to appear in an appreciable percentage in the finished product.

In witness whereof, I, hereunto subscribe my name this thirtieth day of December, A. D., 1908.

ALBERT E. GREENE.

Witnesses:

GEORGE E. FOLK,
ALFRED H. MOORE.

(P. 1334)

DEFENDANTS' EXHIBIT 144

A. P. STROHMENGER.

ELECTRIC DEPOSITION OF METALS.

APPLICATION FILED APR. 11, 1913.

1,041,525. Patented Oct. 15, 1912.

Fig. 1.

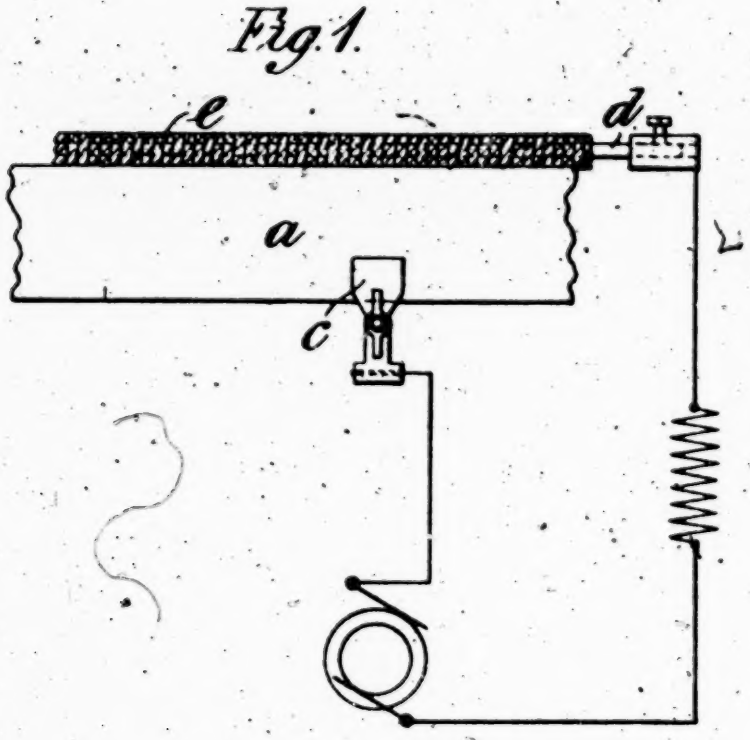
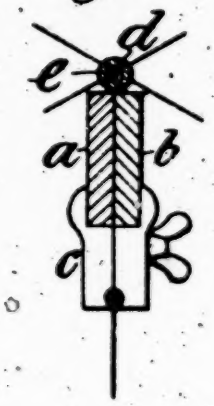


Fig. 2.

Fig. 3.



Witnesses
E. B. Franzoni
M. C. Burdell

Inventor
Arthur P. Strohmenger.
By his attorneys.
Bacon & Wright

(P 1331)

UNITED STATES PATENT OFFICE.

ARTHUR PERCY STROHMENGER, OF WESTMINSTER, LONDON, ENGLAND.

ELECTRIC DEPOSITION OF METALS.

1,041,525. Specification of Letters Patent. Patented Oct. 15, 1912.

Application filed April 11, 1912. Serial No. 690,124.

To all whom it may concern:

Be it known that I, ARTHUR PERCY STROHMENGER, a subject of the King of Great Britain, residing at Caxton House, Westminster, London, England, have invented new and useful Improvements in the Electric Deposition of Metals, of which the following is a specification.

The usual method of depositing metal by means of the electric arc or of electric welding is to hold the electrode in the hand, to place it in contact with the work, and to withdraw it, thus starting the arc, and then to move the electrode along the work. Now in practice when using a metal electrode it is difficult to hold the electrode quite steady and to move it along at a uniform and correct distance from the work, and this is especially the case in small work such for instance as barrel welding when the current employed must be comparatively small and therefore the arc is short.

According to this invention I secure the electrode which is suitably coated with some fusible insulating covering upon the work and along the whole length of the line along which the metal is to be deposited or of the seam to be welded. The covering should be of such a thickness that the metal electrode is supported by it at the proper distance from the work.

The accompanying drawing illustrates the invention.

Figure 1 is a side view and Fig. 2 a cross section. Fig. 3 is a view similar to Fig. 2 but showing a modification.

a b are two pieces of metal to be welded together; they are supported in a vise or clamp *c* and are connected to one pole of a source of alternating current. *d* is the electrode connected to the other pole of such source and coated with fusible insulating material *e*.

It is in many cases advantageous to lay two or more conductors side by side as shown in Fig. 3. and to connect them in parallel so that two or more arcs are formed, the resulting streams of metal uniting. The weld produced by such an arrangement is more regular than when the electrode consists of a single conductor. In such a case it is not necessary to insulate each one of the conductors separately.

The insulating material which I prefer to use is asbestos spun into the form of a yarn and smeared with a suitable composition such as sodium silicate, aluminum silicate and the like to vary the fusing temperature of the yarn; and the asbestos which I find to answer best is blue asbestos which is a ferrous silicate and acts rather as a reducing than as an oxidizing agent so that it must effectually prevent oxidation of the deposited metal.

The thickness of the material *e* will depend upon the size of the electrode and the strength of the current, the greater the current the thicker being the material.

The electrode may be secured in position by tying it to the work with string or by other convenient means. The end of the electrode is bared and an arc is struck by a piece of carbon or other convenient means; the arc fuses the covering and melting the electrode moves slowly along the seam. The fused covering acts as a flux and prevents the molten metal coming in contact with the air, thus preventing porosity.

When welding an alloy it usually happens that there is a greater loss from the crater area *i. e.* that part of the work which is intensely heated of one or more of the constituents of the alloy than of the remainder, so that the composition of the resulting metal is not quite the same as that of the work. This loss which is dependent upon the current density can be determined beforehand and I therefore form the electrode of an alloy which contains an amount of such constituent or constituents in excess of the amount required in the resulting metal, the excess being equal to the amount lost. For instance in welding steel there is a loss of carbon and I therefore use an electrode having a greater carbon content than is required in the resulting metal, the excess being equal to the loss from the crater area which can be predetermined beforehand. Similarly if the steel contain vanadium for instance, I use an electrode containing a suitable excess of that metal.

What I claim is:—

1. A process of depositing metal by means of the electric arc, which comprises connecting the work to one pole of a source of electric current, laying an insulated metal electrode along the line on which metal is to be deposited, connecting this electrode to the other pole of the source of current, and striking an arc between the work and the end of the electrode.

2. A process of depositing metal by means

of the electric arc, which comprises connecting the work to one pole of a source of electric current, laying a plurality of insulated metal conductors forming an electrode along the line on which metal is to be deposited, connecting these conductors in parallel to the other pole of the source of current, and striking an arc between the work and the ends of the electrode.

3. A process of depositing metal by means of the electric arc, which comprises connecting the work to one pole of a source of electric current, laying a metal electrode covered with asbestos yarn along the line on which metal is to be deposited, connecting this electrode to the other pole of the source of current, and striking an arc between the work and the end of the electrode.

4. A process of depositing an alloy by means of the electric arc which comprises connecting the work to one pole of a source of electric current, laying along the line on which alloy is to be deposited an insulated electrode of an alloy which contains an excess of one of the constituents of the work, connecting this electrode to the other pole of the source of current, and striking an arc between the work and the end of the electrode.

5. A process of electric welding, which comprises placing the two pieces of metal to be welded side by side, connecting them to one pole of a source of electric current, laying an insulated metal electrode along the seam, connecting this electrode to the other pole of the source of current, and striking an arc between the work and the end of the electrode.

6. A process of electric welding, which comprises placing the two pieces of metal to be welded side by side, connecting them to one pole of a source of alternating electric current, laying an insulated metal electrode along the seam, connecting this electrode to the other pole of the source of current, and striking an arc between the work and the end of the electrode.

7. A process of electric welding, which comprises placing the two pieces of metal to be welded side by side, connecting them to one pole of a source of electric current, laying a plurality of insulated metal conductors forming an electrode along the seam, connecting these conductors in parallel to the other pole of the source of current and striking an arc between the work and the ends of the electrode.

8. A process of electric welding, which comprises placing the two pieces of metal to be welded side by side, connecting them to one pole of a source of electric current, laying a metal electrode covered with asbestos yarn along the seam, connecting this electrode to the other pole of the source of current and striking an arc between the work and the end of the electrode.

9. A process of electric welding, which comprises placing the two pieces of metal to be welded side by side, connecting them to one pole of a source of electric current, laying a metal electrode covered with blue asbestos yarn along the seam, connecting this electrode to the other pole of the source of current and striking an arc between the work and the end of the electrode.

10. A process of electric welding, which comprises placing the two pieces of metal to be welded side by side, connecting them to one pole of a source of alternating electric current laying a plurality of insulated metal conductors forming an electrode along the seam, connecting these conductors in parallel to the other pole of the source of current and striking an arc between the work and the ends of the electrode.

11. A process of electric welding which comprises placing the two pieces of metal to be welded side by side, connecting them to one pole of a source of electric current, laying along the seam an insulated electrode of an alloy which contains an excess of one of the constituents of the pieces to be welded, connecting this electrode to the other pole of the source of current, and striking an arc between the work and the end of the electrode.

ARTHUR PERCY STROHMENGER.

Witnesses:
W. SLAUGHTER,
C. J. WORTH.

UNITED STATES PATENT OFFICE.

PERCY A. E. ARMSTRONG, OF NEW YORK, N. Y., ASSIGNOR TO WALTER L. CLARK AND ARTHUR H. ADAMS, A COPARTNERSHIP UNDER THE NAME OF THE QUASI-ARC COMPANY, OF NEW YORK, N. Y.

WELDING-ELECTRODE AND PROCESS OF WELDING.

1,241,899. Specification of Letters Patent. Patented Oct. 2, 1917.

No Drawing. Application filed March 10, 1915. Serial No. 13,469.

To all whom it may concern:

Be it known that I, PERCY A. E. ARMSTRONG, of New York city, in the county of New York, and in the State of New York, have invented a certain new and useful Improvement in Welding-Electrodes and Processes of Welding, and do hereby declare that the following is a full, clear, and exact description thereof.

My invention relates to welding electrodes and processes in which an electric current is employed to fuse a metal electrode, so that the fused metal is deposited upon a metal surface or surfaces which are to be thereby welded or patched.

Objects of my invention are to provide electrodes by which metal may be deposited solid and free from blow holes, a spongy condition or impurities, and by which the deposited metal can readily and conveniently be made to have any desired composition.

My invention is capable of embodiment in and of being practised by the use of various electrodes and with many variations of details, and the embodiments thereof by which I shall illustrate it are therefore to be regarded as typical only of many possible embodiments, and my invention is not to be confined to the details of such embodiments.

According to my invention, a metal rod of any desired shape and composition is coated with an inner and an outer coating, preferably of an essentially insulating nature, and preferably essentially non-metallic and adapted to act as a slag when fused. The rod may be of any material desired to be deposited, such as cast iron, iron, steel, alloyed steels, brass, copper or aluminum. In the present instance, it may be of manganese steel. The inner coating, according to my invention, has a lower melting or fusing point than the outer coating, but such fusing point may be either higher or lower than that of the metal core of the electrode, according to the class of work to be welded, patched or reinforced. For overhead and vertical work, the inner slag is preferably made equal to or of a slightly higher melting point than the metal core. But the metal will work with an inner slag of a lower fusing point than that of the metal core. For horizontal work, I preferably make the inner coating of a lower fusing point than that of the metal core, but it is quite possible to obtain excellent results with the inner slag of a higher melting or fusing point than the metal core.

The inner coating may consist of any suitable material or combination of materials such as blue asbestos, which may be in the form of yarn and smeared with a suitable composition, such as sodium silicate, aluminum silicate, or any other suitable, well-known composition, that will either raise or lower the fusing point of the asbestos as desired, according to the circumstances. This coating, when in the form of a yarn, may be twisted around or braided on the metal core, or squeezed or cast on to it.

The outer coating may consist of any suitable refractory material or combination of refractory materials, such as refractory clays or a commercial white asbestos, the composition of which is found to be silicon, aluminum oxid, magnesia, calcium, carbon, etc., and I preferably use it in the form of yarn, twisted around or braided or squeezed or cast on the electrode.

The thickness of the wall of the outer slag I preferably make such that a crucible is maintained at the end of the electrode by reason of the fusion of the metal rod, and the inner coating or slag taking place at a lower temperature than that of the outer coacting or slag. I prefer to have the wall of the crucible not thinner than 5% of the diameter of the average cross-section of the metal core of the electrode. The outer coating should be such that on being in contact with the fused deposited metal, it will just fuse and combine with the slag of the inner coating or form a separate slag on top of the already deposited inner slag and deposited molten metal.

While I may use the inner coating as consisting only of materials adapted essentially to form a slag, as before described, and which are essentially non-metallic, the inner slag may have compounded with it various metals or alloys, separate or combined, such as ferro-manganese, ferro-titanium, ferro chromium, ferro tantalum, ferro-tungsten, ferro-vanadium, carbon, etc., so that the inner slag, besides acting as a blanket, so to speak, to cover the deposited

metal and prevent its oxidation from the atmosphere, may serve as a medium for carrying the alloying substances.

For instance, where it is desired to deposit manganese steel, I may use a steel rod or core for the electrode having no manganese therein, or less manganese than or equal to that desired in the deposited metal, and may supply manganese from a ferro-manganese in the inner coating. I find that in this way I can obtain a higher percentage of manganese in the deposited metal than is possible by depending alone upon manganese in the rod or core, because the latter is so readily oxidized.

In the practice of my process by means of my electrode in any of its above described forms, the electrode is connected with the pole of a source of either direct or alternating current, and the circuit is completed through the work. The metallic core of the electrode is brought into contact with the metal on which it is to be fused by direct contact or some interposed conductive body. The metal core then starts to fuse and the inner coating is fused leaving the outer coating to form a shell or crucible-like structure, and in the crucible-like cup or tube thus formed, the metal core or inner slag is fused, the atmosphere being excluded by the crucible so that the fused metal is protected therefrom. There is an expulsive effect due probably to an arc throwing the molten metal away from the metal core, and the crucible or tube acts as a conductor or pipe by which the fused material is directed on the metal to be welded, patched or reinforced. The electrode is held perpendicular to the work or otherwise, according to whatever angle is best suited to accomplishing the operation, and the nearest edge of the crucible is advantagegously held touching the work or the deposited metal or slag, but this latter condition is not essential. The current will determine the greatest distance from the work at which the electrode may be held.

The outer coating should just fuse at such a rate as to maintain a sufficient crucible and yet flow on to the work sufficiently rapidly so that the arc if there be one, will not become too long.

That feature of my invention by which I provide the inner coating with the alloying elements, when it is used, is very advantageous because it has been found that when a bare metallic electrode is used to deposit metal upon a body, it has, during the process of fusion, lost much of the alloying elements and absorbed oxygen, and it is to overcome this defect and give a better deposited metal that slag has been heretofore melted down with the metallic electrode, but even this has not prevented a loss of alloy in the deposited metal nor the formation of oxid in the latter, and it has been necessary to provide the metal core with an excess of the alloying elements so that the loss could, to some extent, be compensated. By my invention I obviate this defect to a large degree, and I not only have a control over the composition of the metal deposited but I can obtain depositions of a large variety of compositions by the use of cores of a standard composition, and inner coatings with various alloys mixed therewith. The intimate and complete mixing taking place in the crucible at the end of the electrode insures a good mixture of the various elements. The metallic core is deposited and the molten metal core is covered with slag during the whole time it is being deposited and until it cools. The metal thus deposited will be free from occluded gas holes and contain the required alloys.

I claim:

1. An electrode, comprising a metal core having an inner coating adapted to form a slag which will protect the deposited molten metal from gaseous attack, and an outer slag adapted to form a crucible that shall protect both said molten metal and slag, said outer coating being fusible but at a higher temperature than said inner coating.

2. An electrode comprising a core of manganese steel and inner and outer coatings of insulating material adapted to act as a slag when fused, the outer coating being of a higher melting point than the inner one.

3. An electrode comprising a metal core having inner and outer coatings of insulating material that is adapted to act as a slag, said coatings having different melting points.

4. An electrode comprising a metal core having inner and outer coatings of insulating material that is adapted to act as a slag, said coatings having different melting points, the melting point of the inner coating being lower than that of the outer coating.

5. An electrode comprising a metal core having inner and outer coatings of insulating material that is adapted to act as a slag, said coatings having different melting points, the melting point of the outer coating being higher than that of the metal and of inner coating.

6. An electrode comprising a metal core having inner and outer coatings of insulating material adapted to act as a slag when fused, the inner coating comprising blue asbestos.

7. An electrode comprising a metal core having inner and outer coatings of insulating material adapted to act as a slag when fused, the inner coating comprising blue asbestos combined with a silicate.

8. An electrode comprising a metal core having inner and outer coatings of insulating material adapted to act as a slag when fused, the inner coating comprising blue asbestos combined with sodium silicate.

9. An electrode comprising a metal core having inner and outer coatings of insulating material adapted to act as a slag when fused, the outer coating comprising white asbestos.

10. An electrode comprising a metal core having inner and outer coatings of insulating material adapted to act as a slag when fused, the inner coating comprising blue asbestos and the outer coating comprising white asbestos.

11. An electrode comprising a slag forming sleeve, a second slag forming element, and a metal-depositing element.

12. An electrode comprising a slag forming sleeve, a second slag forming element, and a metal-depositing element, said sleeve having a higher fusing point than said second slag forming element.

13. An electrode comprising a slag forming sleeve, a second slag forming element, and a metal-depositing element, said sleeve having a higher fusing point than said second slag forming element, and providing a crucible for containing and protecting both of said elements.

14. An electrode comprising a metal rod or core, and a coating of insulating material adapted to act as a slag when fused, said coating comprising elements to be combined with the deposited metal, and an outer coating of insulating material adapted to act as a slag when fused, said outer coating having a higher melting point than said inner coating.

15. An electrode comprising a metal rod or core and a coating of insulating material adapted to act as a slag when fused, said coating comprising alloys adapted to be combined in depositing with the metal of the core, and an outer coating of insulating material adapted to act as a slag when fused, said outer coating having a higher melting point than said inner coating.

16. An electrode comprising a metal rod or core, and a coating of insulating material adapted to act as a slag when fused, said coating comprising alloys adapted to be combined in depositing with the metal of the core, such as a ferro-manganese, and an outer coating of insulating material adapted to act as a slag when fused, said outer coating having a higher melting point than such inner coating.

17. The process of depositing metal by an electric current which comprises coating a metallic electrode with an insulating material adapted to act as a slag when fused, and so maintaining said coating in contact with the work, and melting it by means of an electric current, that such coating forms a crucible for the molten metal.

18. The process of depositing metal by means of an electric arc consisting in coating a metallic electrode with inner and outer coatings of insulating material adapted to act as a slag when fused, the outer coating having a higher melting point than the inner coating, and melting said electrode by means of an electric current, and so maintaining the electrode near the work that such outer coating forms a protecting crucible about the metal being deposited.

19. The process of depositing metal by means of an electric current comprising coating a metallic electrode with inner and outer coatings of insulating material adapted to act as a slag when fused, said outer coating being of a higher melting point than said inner coating, and combining with said inner coating alloying materials desired to be combined with the metal of said rod, melting said rod by means of the electric current, and so maintaining said rod near said work that said outer coating shall form a crucible protecting the molten metal.

In testimony that I claim the foregoing I have hereunto set my hand.

PERCY A. E. ARMSTRONG.

Witnesses:
EDWIN J. PRINDLE,
MARIAN I. DEMPSEY.

(P. 1346)

UNITED STATES PATENT OFFICE.

ANTOINE B. PESCATORE, OF LONDON, ENGLAND.

ELECTRODE FOR ARC-SOLDERING.

1,277,639. Specification of Letters Patent. Patented Sept. 3, 1918.

Application filed June 10, 1918. Serial No. 239,343.

To all whom it may concern:

Be it known that I, ANTOINE BONAVENTURE PESCATORE, a citizen of the Grand-Duchy of Luxemburg, residing at 24 Upper Hamilton Terrace, London, N. W., England, have invented certain new and useful Improvements in Electrodes for Arc-Soldering, of which the following is a specification.

This invention relates to electrodes of the kind having a covering of a slag-forming material, and which are used for the electric arc soldering or welding of iron or steel. Hitherto these electrodes have been made of square or more generally of round rods of iron or steel, covered with blue asbestos or with a layer of granular or powdered slag-forming material mixed with water-glass or some other agglutinant. Good results appear to have been obtained with asbestos cord, wound on round rods. These electrodes are, however, expensive. They have the further defect when of small diameter, that the asbestos cord cannot be made easily under a certain thickness. In consequence the quantity of slag formed in the fusion is excessive, and makes it difficult to weld small sections, where a thin metal rod must be used.

When the blue asbestos or some other and equivalent material is used in the form of a paste, the electrode is less costly, but the welds produced are not satisfactory. The electrode does not fuse uniformly and in consequence the metal deposited is not continuous. Another defect of the latter type of electrode is due to the fact that the slag-forming material does not always adhere sufficiently to the metal rod.

The invention has among its objects to avoid these defects.

According to the invention an electrode is provided having a cross section variable in the length of the electrode and such that on the fusion of the electrode in use, the arc travels around its circumference or around its edge whereby the electrode fuses regularly, and thus the discontinuity of the metal in the weld resulting from irregular fusion of the electrode is avoided.

The invention comprises the formation of the variable cross section of the electrode for the purpose of effectively supporting the slag forming material whereby the removal or chipping off of this material in transport or handling is avoided, while the invention also comprises the modifications hereinafter described.

In carrying the invention into effect a round iron or steel rod may be employed on which is wound an iron or steel wire, and which is covered by the slag-forming material. Instead of one, two or more wires may be wound on the central rod.

I have found that the wire winding causes the slag forming material to fuse off sharply. In consequence the arc, and the relative positions of the electrode and the weld can be observed more easily when a wire winding is used.

The slag-forming material may be put on as a paste in any convenient way, or it may be put on as a powder after dipping the electrode in water-glass or other agglutinant.

Instead of a central rod around which is wound a wire, the electrode may consist of two or more rods or wires of approximately equal size, twisted around one another; or again an electrode may be made of a single rod of twisted polygonal section or in the form of a screw; or again a round electrode may be used on which a screw thread has been cut.

In the three last mentioned forms, the results obtained are similar to that of the first example, the electrode having such a shape as to give a good hold to the slag-forming material and a regular twisting of the metal or such a disposition of the metal that the arc is caused to move around the axis of the electrode on its fusion in use with a consequent more regular and uniform fusion of the electrode.

When a central rod with one or more wires is used, or two or more wires or rods are twisted together to form the electrode, a further advantage over existing methods of making welding electrodes may be obtained by using different alloys. For instance, the wire may be of a steel containing more carbon, manganese or other metals than that of the rod. This wire will, in consequence, fuse at a lower temperature than the central rod, the effect of this counterbalancing the greater cooling due to the wire being outside the rod. Further, the larger quantities of carbon, manganese, etc., of the steel of which the wire winding is made, make it possible to adjust the quality of the material of the weld in such a manner as to obtain the desired chemical and physical characteristics, independently of or

additional to the adjustment obtained by the proportion between the section of the rod and of the wire or wires, and by the variation in the pitch of the winding.

The powdered or granulated slag-forming material may be put on the rod and wire, or on the twisted rod or wires very conveniently in the following manner:—the rod with the wire wound on it, or the twisted rod or wires, are first dipped in the agglutinant in solution emulsion or other condition. They are then passed through a spray of the powdered or granular slag-forming material, and may at the same time be rotated, in order to obtain a coating of uniform thickness. This operation may be repeated until the desired deposit has been applied.

The slag-forming material is made in the usual way, preferably of a mixture that will on fusion yield a calcium and iron silicate, or of blast furnace slag, and powdered or granular ferro-manganese, aluminium, or any other material acting favorably on the steel or iron may be added thereto.

The invention is illustrated in the accompanying drawings which in Figures 1 and 2 illustrate one modification and in Figs. 3 and 4 another.

Fig. 1 is an elevation and Fig. 2 a transverse section on the line *x*—*y*, Fig. 1, of a modification in which wire *b* is wound around the electrode *a* and both are covered with a slag forming material *c*.

Figs. 3 and 4 are elevation and transverse sections on the line *x*—*y* Fig. 3, respectively in which the electrode a^1 is a twisted rod of polygonal section covered with a slag forming material c^1.

I claim:

1. An iron or steel electrode for use in arc soldering or welding covered with slag-forming material and having a cross-section variable in the length of the electrode and such that on the fusion of the electrode in use, the arc travels around its circumference or edge whereby the electrode fuses regularly substantially as described.

2. An iron or steel electrode for use in arc soldering or welding in which an iron or steel wire forming part of the electrode is embedded in the slag forming material, for the purposes and substantially as described.

3. An iron or steel electrode for use in arc soldering or welding as specified in claim 1 in which the electrode is of polygonal shape, substantially as described.

4. In the manufacture of an iron or steel electrode for use in arc soldering or welding as specified in claim 1, the twisting of two or more wires around one another and covering them with slag-forming material, substantially as described.

5. An iron or steel electrode for use in arc soldering or welding as specified in claim 1, in which the electrode is formed in the shape of a screw, substantially as described.

A. B. PESCATORE.

Jan. 9, 1923.

1,441,685.

E. H. JONES.

ELECTRIC ARC SOLDERING.

FILED SEPT. 18, 1918.

FIG. 1.

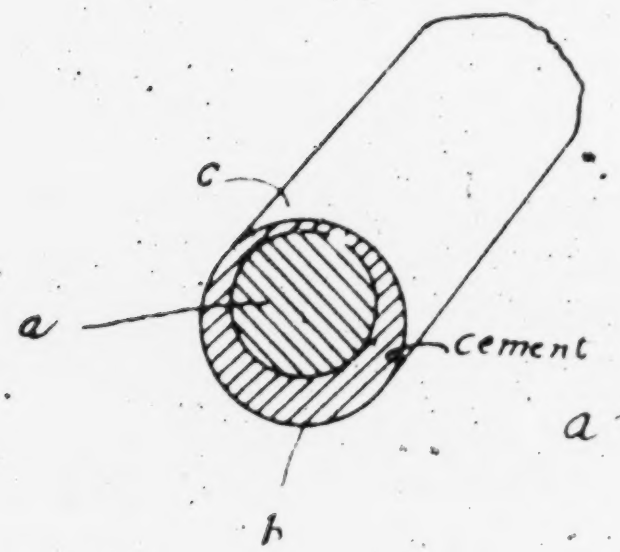
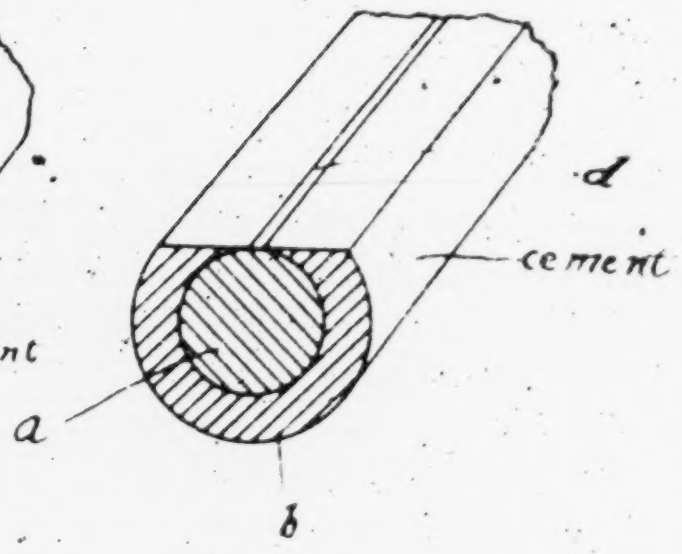


FIG. 2.



INVENTOR:

Ernest Henry Jones

By Wm Wallace White

ATTY

1432

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Patented Jan. 9, 1923. 1,441,685

UNITED STATES PATENT OFFICE.

ERNEST HENRY JONES, OF LONDON, ENGLAND.

ELECTRIC-ARC SOLDERING.

Application filed September 18, 1918. Serial No. 254,656.

To all whom it may concern:

Be it known that I, ERNEST HENRY JONES, subject of the King of Great Britain, residing at 4 Grange Road, Canonbury, London, England, have invented new and useful Improvements in Electric-Arc Soldering, of which the following is a specification.

In order to prevent the oxidation of the molten metal, metal electrodes used in soldering by the electric arc, or in the deposition of metal by the same means, are provided with a casing or coating which fuses in the electric arc and forms a protective slag to prevent access of air to the molten metal.

Various substances in which silica predominates, are used to form this casing for the electrodes, and among others may be mentioned, iron ore sand in the form of slag sand or slag wool, or in other convenient form; asbestos formed into yarn soaked or smeared with silicate of soda and wound on to the electrode; mixtures of crushed limestone, carbonate of potassium and silicate of alumina, with or without magnesite or dolomite, or bauxite, and other materials, mixed into a paste with water or spirits, or a mixture of boracic acid, pumice stone, bicarbonate of soda, lampblack or powdered charcoal mixed with water, into either of which the electrode may be dipped so as to obtain a coating which is allowed to dry on but these mixtures, not being in the nature of a cement, readily break away from the electrode.

Hitherto the principal difficulty experienced in the casing of these electrodes has been to apply the casing so that it shall firmly adhere to the electrode and be of even and regular thickness throughout, as regularity of working cannot be obtained if there is any unevenness in the thickness of the casing, since the electric arc inevitably flies to the thin side of the casing and renders regular deposition of metal very difficult to control, but advantage is taken of what is at present a defect, in the latter part of this specification.

By this invention I compound the substances to form the casing of such material as to form a cement which shall set on drying, and I may take for example, 3 parts of finely powdered slag sand and 1 part of slacked lime mixed with a sufficiency of water, and to render the compound more tenacious I may add to the water for example, a proportion of silicate of soda or other suitable silicious material.

It is obvious that a ready made cement may be used with the silicious material, and such may be used if it is free from any substance which may have a deleterious effect upon the molten metal.

It is necessary that whatever compound is used shall be capable of being extruded under pressure upon the electrodes by means of an extruding machine through an opening or die. The electrode may subsequently be drawn through a heated pipe in order to dry and set the coating.

The extruding machine may be similar in design, for example, to the well known machine for covering electric cables with lead.

The operation of coating the electrodes may be made continuous by drawing wire through a straightening machine, then through the extruding machine, and finally through a drying pipe before being cut into suitable lengths.

In the accompanying drawings exaggerated sections of electrodes are shown, Fig. 1 representing an electrode provided with a casing which is thin along one side and Fig. 2 representing an electrode provided with a casing which is removed from one side to bare the electrode. *a* is the electrode, and *b* is the casing.

In using a prepared electrode it has been mentioned above that the electric arc flies to the thin side of the casing *b*, and according to the thinness of the casing at that point the arc is projected outwardly more or less, and where the casing has been purposely made very thin as shown at *c* in Fig. 1 or the electrode has been bared as shown at *d* in Fig. 2 the arc is projected outwardly almost to a right angle, and accordingly I purposely provide a thin side to certain electrodes or bare one side of the electrodes so that the arc may be projected towards the line of welding or soldering in order to preheat it in advance of the actual welding or soldering operation, and by this means I moderate the effect of the arc at the actual point of contact with the work and gain very materially in efficiency. By the same means a slight irregularity in the remaining portion of the casing would not cause the arc to fly to that part.

I claim:—

1. In metal electrodes for electric arc soldering, compounding the materials of the

casing to form a cement which sets on drying as set forth.

2. In the method of forming metal electrodes for electric arc soldering as claimed in the preceding claim, using a ready made cement as set forth.

3. In metal electrodes for electric arc soldering a casing having a thin side or a baring of one side of the metal to locate the arc as set forth..

4. In metal electrodes for electric arc soldering, compounding the materials of the casing to form a cement, extruding the same upon the electrode, and allowing the casing to set on drying, as set forth.

5. In metal electrodes for electric arc soldering, compounding the materials of the casing with a suitable ready made cement, extruding the same upon the electrode, and allowing the casing to set on drying, as set forth.

6. In metal electrodes for electric arc soldering, compounding together 3 parts of finely powdered slag sand, 1 part of slaked lime, mixing therewith a sufficient quantity of water to form a paste, adding thereto a sufficient quantity of a silicious material to render the paste adhesive, and extruding said paste upon the electrode to form a casing therefor.

In testimony whereof I have signed my name to this specification.

ERNEST HENRY JONES.

Patented Apr. 15, 1930 1,754,566

UNITED STATES PATENT OFFICE

WILBER B. MILLER, OF FLUSHING, NEW YORK, ASSIGNOR TO OXWELD ACETYLENE COMPANY, A CORPORATION OF WEST VIRGINIA

WELDING

No Drawing. Application filed January 27, 1926. Serial No. 84,241.

The invention relates to rods or the like for metal-depositing operations, such as fusion welding. Rods prepared in accordance with the invention may be used in either the arc process or the blowpipe process.

The difficulty most often encountered in fusion welding is in depositing the metal in a clean and homogeneous condition and in securing a firm bond with the metal on which the deposit is made. It is sometimes desirable to add to the metal as it is deposited a constituent not already present, or to increase the content of a constituent already present, but as a general rule it is preferable to produce a rod of such composition that the introduction of elements during the welding operation will be unnecessary. Successful welding then becomes merely a question of depositing the metal in suitable physical condition and of preventing or controlling the loss of constituents therefrom, as by oxidation, while the metal is molten.

According to the present invention, the welding rod or the like is provided with a coating partially or completely enclosing it, the composition of the coating being such that a slag of molten manganese silicate will be formed during the welding or other depositing operation. The addition to the deposited metal of chemical elements present in the coating is not precluded, and in general will occur, at least to a small extent, but the principal purpose of the coating is to produce a slag blanket which will prevent or diminish the loss of chemical elements from the deposited metal, prevent or diminish absorption by the metal of atmospheric and combustion gases, and promote the deposition of the metal in a clean, sound, and homogeneous condition without unduly taxing the skill of the welder.

In addition to the primary object of providing a blanket of molten manganese silicate I may also provide auxiliary slag constituents efficacious in dissolving oxidation products formed from the deposited metal, and in some cases I may also incorporate in the coating reducing and degasifying agents to counteract the effect of gases which, in spite of the slag blanket already referred to, come into contact with the molten metal.

The invention may be embodied in a rod having a coating of manganese silicate applied thereto in any suitable way as by powdering it, mixing the powder with a binder such as dilute alcoholic shellac, immersing the rod in the mixture; and then withdrawing the rod and allowing the adherent material to harden. The manganese silicate may more or less closely approach the composition represented by the formula $MnO.SiO_2$, but an excess of either manganese oxide or silica may be present.

Instead of preformed manganese silicate the coating may contain material adapted to react at the temperature of the metal-depositing operation to produce manganese silicate. This is the preferred form of the invention as it permits one operation to be dispensed with. The coating may contain for example an oxide ore of manganese and any finely divided form of silica. As in the case of the preformed silicate the proportions may be such that $MnO.SiO_2$ or a more basic or acidic silicate will be formed.

Under some conditions it is desirable to replace the manganese oxide with a composition containing manganese in unoxidized condition, such as manganese metal or a manganese alloy. The greater portion of the manganese present in the coating will usually be oxidized during the depositing operation and the oxide formed will be immediately available for the formation of manganese silicate. Unoxidized manganese when present in the coating produces a strongly deoxidizing condition to which the molten metal is subjected and this favors the deposition of sound metal.

Likewise the silica may be replaced by unoxidized silicon, either as commercially pure elemental silicon or as a silicon alloy. Silicon, as is well known, is a powerful deoxidizing agent, and its oxidation product (silica) will combine with any manganese oxide present to form the desired silicate.

I prefer to have manganese present in the coating in both oxidized and unoxidized form, and also prefer to have both unoxidized

DEFENDANTS' EXHIBIT 145

Patented Sept. 11, 1923. **1,467,825**

UNITED STATES PATENT OFFICE.

JAMES C. ARMOR, OF WEST VIEW BOROUGH, PENNSYLVANIA.

ARC-WELDING COMPOSITION.

No Drawing. Application filed August 9, 1921. Serial No. 490,919.

To all whom it may concern:

Be it known that I, JAMES C. ARMOR, a citizen of the United States, and residing in the borough of West View, in the county of Allegheny and State of Pennsylvania, have invented or discovered the new, useful, and Improved Arc-Welding Composition, of which the following is a specification.

My invention consists of a new and improved compound for use in connection with electric-arc welding, for the purposes, inter alia, of using a lower impressed voltage than is now possible with the compounds now in general use, and of obtaining a dense, uniform weld of great strength, and free from slag and other impurities.

Generally speaking, my improved compound is characterized by zirconia. Thus I may use a zirconate of an alkali, such as sodium zirconate. Or, I may use zircon or any other natural form of zirconium, together with an alkali or alkali earth.

Where zirconia in a neutral or acid form is used, it must be combined with an alkaline substance, as by precipitation or fusion.

Thus I may fuse pure zirconia (ZrO_2) with an equal weight of soda ash. If zircon is to be used, I fuse ten parts of zircon with twelve parts of soda ash.

The percentage of sodium may be varied through wide limits, or it may be replaced, either entirely or in part by lithium, potassium, calcium, strontium or barium.

Thus, instead of soda ash, I may use potassium carbonate, obtaining potassium zirconate; or I may use lithium carbonate, obtaining lithium zirconate.

This product may be used alone as a welding compound, but I prefer to dilute or combine the same with a suitable flux having a melting point near, preferably lower than, the melting point of the metal to be welded.

Thus, where mild steel is to be welded, I use a flux composed of silicates of iron, aluminum and manganese, together with, preferably, an alkaline substance or substances.

Thus I may use the following formula for the purpose:

	Weight.
Sodium zirconate	6%
Clay	38%
Ferric oxide	10%
Manganese dioxide	8%
Soda ash	38%
	100%

These elements are preferably fused together and then pulverized; or they may be merely pulverized and thoroughly mixed.

The percentage of clay may vary or it may be replaced to a greater or less extent by silica or alumina.

The metallic oxides may vary through wide limits or be entirely absent.

For special purposes, I may add other substances, such, for instance, as powdered aluminum, to purify the metal, or nickel to form nickel steel.

In use, the composition is applied to the wire or rod which forms the electrode, and as the wire or rod is melted to form the weld, the zirconia enters the weld and causes the formation of a dense, uniform and very strong weld.

The flux is fused and rises to float on the surface of the metal forming the weld, dissolving out the impurities in the metal, and, by the formation of a protective coating, preventing the oxidation and the absorption of nitrogen from the atmosphere. The flux also serves to dilute the zirconate and thus cheapen the composition.

What I desire to claim is:—

1. An arc-welding composition containing zirconia.

2. An arc-welding composition containing zirconia combined with an alkaline substance.

3. An arc-welding composition containing zirconia combined with a flux.

Signed at Pittsburgh, Pa., this 6th day of August, 1921.

JAMES C. ARMOR.

(1935 P. 138)

Patented Dec. 24, 1929 1,741,031

UNITED STATES PATENT OFFICE

WILBER B. MILLER, OF FLUSHING, NEW YORK, ASSIGNOR TO OXWELD ACETYLENE COMPANY, A CORPORATION OF WEST VIRGINIA

WELDING FLUX

No Drawing. Application filed January 27, 1926. Serial No. 84,242.

The invention relates to fluxes for fusion welding.

When abutting edges of metal members are fused and caused to unite by the heat of the electric arc or the blowpipe flame, or when a metal rod or electrode is fused by one of the above methods and the molten metal is deposited for the purpose of welding abutting metal members or for building up or sheathing a single member, difficulty arises, as is well known, in bringing the fused metal into a solid condition in which it is clean, sound and homogeneous, firmly bonded to the adjacent metal, and not excessively altered in its chemical composition. To assist in bringing about the desired condition fluxes in wide variety have been employed.

From the great diversity of fluxes which have been proposed for such use and from the mediocre degree of success which has attended their use, it is evident that a full understanding of the functions and essential properties of such fluxes has not been attained. The following are the desirable qualities of a flux for most welding operations. The flux should melt readily and its surface tension when molten should be such that it will readily adhere to the work as the latter is heated, instead of falling away or being blown away. A dense and quiet liquid will be more stable in the welding position than a very thin or frothy liquid, and the flux should therefore produce a liquid of this nature. As the temperature is increased toward the welding point the fluidity of the molten flux should not become so great as to cause undue difficulty in holding it where desired. The flux should be substantially non-volatile at the welding temperature and furthermore should not evolve such quantities of gases, as by decomposition of its constituents or reaction among them, that the flux puffs or froths away from the surface of the molten metal. A flux of these properties will afford a protective blanket of maximum efficacy for the molten metal, and will protect the metal from oxidation throughout the entire temperature range where protection is desirable. The flux should also be a good solvent for metal oxide which may be produced in spite the protective action of the flux, and of course should add no deleterious ingredient to the fused metal and should evolve no fumes offensive to the welder.

I have found that the above requirements are met in admirable fashion by a flux consisting of a borosilicate glass, such as the sodium glass. The glass may be preformed or materials may be subjected to the welding heat so that they react to produce the desired glass. The melting point of the glass will be depressed by increasing contents of alkali and boric oxide, while its viscosity and hence stability in the upper temperature range will be increased by raising the silica content. The borosilicate glasses when in the fused state undergo relatively slight change in fluidity throughout a wide temperature range, and this property is one of the principal causes of their effectiveness when used as welding fluxes. The property is so strongly developed in the borosilicate glasses that it is exhibited by glasses of quite widely varying composition.

If a preformed glass is used it evolves no gases upon heating, while if the glass is formed in situ the reacting materials can be such that gases are not evolved. The borosilicate glasses are excellent solvents for most metal oxides and their oxide-dissolving power is exercised in an especially advantageous way when they are used as fluxes in welding with a chromium alloy, such as chrome iron. Such welding has heretofore been regarded as extraordinarily difficult since chromium oxide is very readily formed and is of such a character that it must be speedily and effectively dissolved else it will seriously impair the weld. A good protective slag over the molten metal is also especially desirable when welding with chromium alloys, particularly when the blowpipe process is used. Borosilicate glasses are accordingly very good fluxes for welding with chromium alloys.

A glass suitable for use as a flux can be cheaply and easily prepared by fusing ordinary borax, which is sodium tetraborate crystallized with ten molecules of water, together with silica, the latter preferably in finely divided form, until a homogeneous frit results.

The preferred proportions are from two to four parts of borax to one of silica, though higher proportions of borax may be used to produce fluxes for welding with alloys of lower melting point than chrome iron, the high borate glasses having sufficient viscosity where high welding temperatures are unnecessary. Satisfactory glasses contain SiO_2 5 to 50%, B_2O_3 20 to 65%, and base 15 to 30%. The alkaline earth oxides may replace the alkali metal oxides in whole or in part. The best results in welding chrome iron have been had with a glass made by fusing about 3.5 parts of borax with one part of silica and therefore containing about four parts of boric oxide to three parts of silica.

Glasses within the proportions given above are substantially insoluble in water but with higher alkali contents the solubility increases slightly. The fusion or frit is preferably poured into water, or onto a chill plate, and is powdered and applied to the weld in any suitable way. I prefer to make a paste of it using a suitable agglutinant such as gum arabic, dextrin, or shellac, and to apply this paste to the rod or electrode, or to the work, or to both, and let it solidify before starting to weld. The glass can of course be used as a core in a hollow electrode or welding rod. A simple water paste of the powdered glass may also be used, especially for application to the work.

I am aware that in the multiplicity of welding fluxes which have been proposed there are some which contain both boric oxide or a borate, and silica or a silicate, so that a borosilicate glass might be formed when the flux is heated to the welding temperature. In all such fluxes which have come to my attention any borosilicate glass produced would be only a minor constituent of the flux and would be intermixed with such a quantity of materials of undesirable properties that the glass would lose its identity and practically all its advantageous qualities would be sacrificed. For example, a flux has been proposed which contains 10% of borax and 5% of silica, the other 85% being alkali metal carbonates and bicarbonates. It will be obvious to those familiar with the chemical properties of the substances involved that in this flux any borosilicate glass formed would be so diluted with readily fusible bases that the character of the flux would be completely changed. Because of its lack of viscosity at elevated temperatures and its propensity for evolving carbon dioxide, this prior flux would not possess the advantages attained by the invention. A flux has also been proposed which may contain $KNaSiO_3$ and B_2O_3 together with a preponderating proportion of alkali metal and alkaline earth metal carbonates. The function of the silicate and boric oxide is said to be to liberate carbonic acid from the carbonates contained in the flux. While my invention does not require complete exclusion of ingredients other than borosilicate glasses, but on the contrary recognizes that auxiliary agents may be useful in the flux in some instances, all compositions embraced by the invention exhibit the characteristic properties of borosilicate glasses and do not contain diluting, low-melting, gas-forming, or other substances in such quantities as to destroy or counteract the desirable properties of the glasses. The words "consisting substantially of borosilicate glass" as used in the claims are intended to exclude all compositions wherein the advantageous properties of borosilicate glasses are seriously impaired by the admixture of other substances with the glass.

Certain subject-matter claimed herein is disclosed in my application Ser. No. 57,944, filed September 22, 1925.

I claim:

1. A welding flux in which, when proximately analyzed according to the following scheme, (*a*) B_2O_3; (*b*) SiO_2; (*c*) oxides of alkali and alkaline-earth metals; (*d*) undetermined; (*e*) volatile below welding temperatures; item (*a*) represents 20% to 65% of the aggregate items (*a*), (*b*), and (*c*); item (*b*) represents 5% to 50% of said aggregate; item (*c*) represents 15% to 30% of said aggregate; and said aggregate is large as compared with item (*d*).

2. The process of welding which comprises fusing metal and depositing the same on heated metal under a molten flux containing 20% to 65% of B_2O_3; 5% to 50% of SiO_2, and sufficient base to form a glass.

3. The process of welding which comprises fusing a chromium alloy and depositing the same on heated metal under a molten flux containing 20% to 65% of B_2O_3; 5% to 50% of SiO_2, and sufficient base to form a glass.

In testimony whereof, I affix my signature.

WILBER B. MILLER.

Patented Feb. 25, 1930 1,748,785

UNITED STATES PATENT OFFICE

WILBER B. MILLER, OF FLUSHING, AND ARTHUR R. LYTLE, OF ELMHURST, NEW YORK, ASSIGNORS TO OXWELD ACETYLENE CO., A CORPORATION OF WEST VIRGINIA

FLUX

No Drawing. Application filed August 28, 1928. Serial No. 302,649.

Our invention relates to fluxing materials, and particularly to fluxes adapted to autogeneous welding. It has for one of its principal objects the provision of a flux adapted to use in the welding of the aluminum bronzes.

Forge welding processes are very old, and the art of fluxing in such processes is well developed, but they are found to be applicable to only a very limited number of the list of known metals and alloys. The new process of autogeneous or fusion welding has opened a broadly new field of operations for welding methods. It is found, however, that the old art of fluxing as applied to forge welding is almost entirely inapplicable to the new fusion welding process and accordingly a broadly new art of fluxing, applicable thereto is in process of development.

Our invention provides a new and useful flux for fusion welding processes whereby metals and alloys, unweldable by prior methods, may readily be welded and a new and useful weld obtained. The aluminum bronzes particularly have been found extremely difficult to weld because of the high temperatures required, and the rapid production of a surface layer at the weld of mixed aluminum and copper oxides, infusible at the welding temperature, which prevents coalescence of the metal. Our invention provides a new, useful and simple combination of previously known fluxing substances, which when combined according to our invention permit of the simple, rapid, and easy welding of the aluminum bronzes and of other metals.

Our flux consists, in essence, of the substances borax, silica and a fluoride, combined in a particular manner, which when so combined produces a flux having the desired properties.

Other objects and details of our invention will be apparent from the following description:

In the preparation of the flux of our invention we find it convenient first to prepare a boro-silicate glass by fusing together from 2 to 4 parts of ordinary borax and one part of silica, both materials being preferably in a finely divided form and thoroughly mixed before fusion. The fusion of the two substances is desirably continued until a homogeneous melt results. To this melt may then be added about one part of lithium fluoride. This may be added to the melt while in the fused condition or after cooling and grinding. In the former instance the material may then be cooled and pulverized. The preparation may desirably contain about 30% of SiO_2, about 40% of B_2O_3, about 15% of alkali and about 15% of fluorine. These proportions are only approximate and may be varied according to the needs of the welder and the conditions under which the welding is done.

This flux produces several new and useful results hitherto unknown. The viscosity of the mixture is high at the welding temperature of the aluminum bronzes and accordingly the fused flux maintains a tenacious protecting blanket over the fused metal in the weld and is not driven away by the blast of the welding flame as occurs with more fluid fluxes. The flux may conveniently be applied in the form of a water paste made from the pulverized preparation. The flux substances being only slightly soluble in water, the water in the paste does not combine with them to give a product which intumesces, as it does with borax alone, or as it does with mixtures containing hydrated borax. The flux has a satisfactory fluidity permitting it to cover the weld completely, at the welding temperature, as distinguished from silica alone, or from silica admixed with substances which do not lower its melting point. Fluorides are also found to be useless, alone, because of the fact that their melting points are too low and they volatilize when applied at high temperatures.

The boro-silicate glass as produced in the first step of our process is known to have a high solvent power for many of the metal oxides, in addition to its property of excluding air, reducing oxidation of the metal and similar effects. We find that the solvent power of this preparation, particularly for aluminum oxide, is greatly increased by the inclusion of the fluoride substance. Such an inclusion is however, possible only under carefully controlled conditions, since under ordinary conditions a mixture of silicate and fluoride, when heated to the fusing temperature, evolves large quantities of gaseous silicon tetrafluoride, wasting the flux and destroying its fluxing action if the heating is continued for any length of time. We find, in the flux of our invention, that, the silica being combined with the borax, it is held in combination in such a manner that only imperceptible and negligible quantities of silicon tetraflourride are produced. Accordingly the flux of our invention shows a high solvent power for the oxides of aluminum and copper; and the aluminum bronzes which cannot be satisfactorily welded by any other process, become easy alloys to weld when the flux of our invention is used.

We have above described a preferred embodiment of the flux of our invention. We find however, that substantial modification therefrom is possible without departure from the spirit of the invention. The proportion of boric oxide may be varied within the range of 10% to 55%, and the silica over the range of 5% to 45% without loss of utility. The desirable range of fluoride substance is 10% to 50%. Other fluorides than the lithium fluoride may be used. A common fluoride substance is cryolite which is also suitable for inclusion in our flux. Other fluorides such as sodium and potassium fluorides are likewise suitable and the proportion of each may be varied according to the complexity of the welding undertaken.

By our invention we have thus produced a new and useful flux adapted to the welding of many difficult alloys.

While we have disclosed but a limited number of embodiments of our invention, it is capable of still other modifications therefrom without departure from the spirit thereof and we desire therefore that only such limitations shall be imposed upon the appended claims as are stated therein or required by the prior art.

We claim as our invention:

1. A flux containing 10% to 50% of a fluoride, with the remainder principally boro-silicate glass.

2. A flux containing 10% to 50% of lithium fluoride, with the remainder principally boro-silicate glass.

3. A flux containing 10% to 50% of a fluoride, with the remainder principally a boro-silicate glass containing more B_2O_3 than SiO_2.

4. A flux containing 10% to 50% of lithium fluoride, with the remainder principally a boro-silicate glass containing about 40% B_2O_3 and about 30% SiO_2.

5. A flux containing 10% to 50% of a fluoride, with the remainder principally a boro-silicate glass containing about 10% to 55% B_2O_3 and 5% to 45% SiO_2.

In testimony whereof, we affix our signatures.

WILBER B. MILLER.
ARTHUR R. LYTLE.

silicon and silica. Desirable reducing conditions are thus established while a blanket of manganese silicate slag is produced more promptly and abundantly than when preformed manganese oxide and silica, or their equivalent, are absent. By having both manganese and silicon present in unoxidized form the reducing conditions referred to may be maintained without disturbing the balance between manganese oxide and silica. If only one of these elements were present in unoxidized form it will be apparent that the proportion of its oxide present would increase as the oxidation of the element in situ progressed. An advantageous proportion of silicon to manganese in the unoxidized portion of the coating material is about one weight to three.

The unoxidized manganese and silicon can be supplied as a single alloy which may contain in addition to these elements any others which are desirable or harmless. For example an alloy of manganese, silicon, and magnesium may be used, the powerful degasifying action of magnesium being thus brought into play.

It is sometimes desirable to add to the coating an auxiliary flux. Borosilicate glass, for example, is in the molten condition an active solvent for oxides which may be formed from the deposited metal during welding. It takes up chromium oxide with great avidity and is found to be a valuable addition to the coating of a chrome-iron welding rod. Sodium borosilicate glass may be made by fusing borax with silica. Two weights of crystallized borax to one of silica gives a good glass, but the proportions may be varied in either direction. Instead of using a preformed glass, borax, preferably previously dehydrated, and silica may be added to the coating, as the heat of the welding operation will bring about a reaction between them.

Example I

In a specific experiment low carbon steel rods containing not more than 0.10% carbon and not more than 0.15% manganese were coated with a mixture constituted as follows:

Material	Parts by weight
Manganese ore	35
Silica flour	20
Ferromanganese	27
Ferrosilicon	8

The manganese ore contained the equivalent of 73% MnO and 4% SiO_2. The manganese alloy contained 84% Mn and the silicon alloy contained 92% Si. The whole mixture was so proportioned that MnO and SiO_2 were present about as required by the formula $MnO.SiO_2$, and the proportion of unoxidized manganese to unoxidized silicon was about three to one. The rods were used in making oxy-acetylene welds of the single V type. No difficulty was experienced in the welding operation. The average tensile strength of the welds was about 55000 pounds per square inch whereas 45000–47000 per square inch is considered average strength for welds made in the same way with uncoated rods of the same composition. The weld metal had a manganese content of 0.23%.

Example II

In another experiment standard steel electrodes were coated with the mixture described above and used for making welds electrically. The strength and ductility of the welds were decidedly better than when the same electrodes were used without the coating.

Example III

Chrome-iron wires one-eighth inch in diameter and containing 26% chromium were coated with a large variety of mixtures falling within the present invention and tested on electrical welding using 100 amperes at 60 volts. The results were very satisfactory. Excellent results were given by wires coated with the following mixture:

Material	Parts by weight
Manganese ore	35
Silica	20
Mn-Si alloy	35

The manganese ore had the composition given under Example I. The manganese-silicon alloy contained Mn 58%, Si 18%.

Example IV

The procedure of Example III was repeated using the coating mixture of Example I. The results were as satisfactory as in Example III.

Exampe V

The procedure of Example III was repeated using a coating containing equal parts of silica flour, sodium borosilicate glass and a manganese-magnesium-silicon alloy. The glass was made by fusing two weights of crystallized borax with one weight of silica. The alloy had approximately the following composition:

	Per cent
Magnesium	8.5
Manganese	46.3
Silicon	32.8
Iron	7.0
Carbon	0.4

The results were satisfactory but inferior to those of Examples III and IV.

Example VI

The procedure of Example III was repeated using a coating containing:

	Parts
Silica flour	90
Mg-Mn-Si alloy	10

The alloy was the same as in Example V and the results were of the same kind as those obtained in Example V.

The foregoing description refers specifically to rods or electrodes having an external coating of slag-forming materials. A hollow rod containing the slag-forming materials as a core is the equivalent of the externally coated article, and may be regarded as an internally coated rod. The appended claim is intended to embrace all rods or the like wherein an elongated metal member and an elongated body of slag-forming material are so juxtaposed that additional slag or flux is automatically supplied as the extremity of the metal member is fused away.

The compositions described herein for coating welding rods or electrodes can also be used, though usually not so advantageously, in forms other than a coating or core. They may, for example, be used in the form of powder into which the hot rod or electrode may be dipped, or they may be applied to the weld in any other suitable way. The use in welding of the compositions claimed in the appended claim is included in my invention, whether or not the composition is applied to the rod as a coating.

This application is a continuation-in-part of an application filed by me on September 22, 1925, Serial No. 57,944.

I claim:

The process of welding ferrous metals which comprises fusing the metal and depositing the same under a molten slag containing manganese silicate, and introducing into said fused slag an unoxidized element of said silicate at such a rate that the deposited metal is effectually degasified and the fluidity of the slag is not destroyed.

In testimony whereof, I affix my signature.

WILBER B. MILLER.

(P. 1353)

The alloy was the same as in Example V and the results were of the same kind as those obtained in Example V.

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In testimony whereof, I affix my signature.

WILBER B. MILLER.

[fol. 1444] IN THE SUPREME COURT OF THE UNITED STATES,
OCTOBER TERM, 1948

Nos. 184 and 185

STIPULATION RESPECTING RECORD IN THE SUPREME COURT—
Filed Oct. 29, 1948

It is stipulated, by and between the parties hereto:

1. That the record herein in the Supreme Court of the United States shall consist of:

   (a) the printed record filed before the Circuit Court of Appeals;

   (b) all of the exhibits included in the record before the Circuit Court of Appeals which, pursuant to the stipulation of the parties, were omitted from the printed record, as more fully set forth and identified in the stipulation of the parties covering the record upon appeal appearing at pages 952-954 of the printed record filed before the Circuit Court of Appeals;

   (c) proceedings in said Circuit Court of Appeals as follows:

      (i) order taking cause under advisement entered February 13, 1948;

[fol. 1445] (ii) opinion filed April 16, 1948;

      (iii) judgments entered April 20, 1948;

      (iv) petition for rehearing filed April 30, 1948;

      (v) answer to petition for rehearing filed May 10, 1948;

      (vi) order denying rehearing entered May 14, 1948;

      (vii) reference to motion for additional security filed May 19, 1948;

      (viii) order staying mandate and denying motion for additional security entered May 26, 1948, and order entered June 14, 1948, enlarging the stay;

(d) stipulation between the parties entitled "Stipulation for Record Upon Review in the Supreme Court of the United States," filed July 13, 1948; and

(e) this stipulation;

2. That, pursuant to Rule 38 of the Rules of the Supreme Court of the United States:

(a) the printed record before the Supreme Court of the United States shall include:

(i) the printed record as filed in the Circuit Court of Appeals;

(ii) the proceedings above specified upon said review before said Circuit Court of Appeals;

(iii) this stipulation;

(iv) the following exhibits included in the record before the Circuit Court of Appeals which [fol. 1446] were omitted from the printed record in said Court, as follows:

Plaintiff's Trial Exhibit No.	Defendants' Trial Exhibit No.
*125 (Certificate cover through p. 38 only)	*88
*126 (Certificate cover through p. 37 only)	*98-A-Y, inclusive
*127 (Certificate cover through p. 38 only)	*104-A*
*175-A	*142
*175-B	*143
*175-C	*144
—216-S—	*145
*217	
*218-G	
*219	
*220	
*225	
236	

(b) the other exhibits included in the record in the Supreme Court of the United States need not be included in the printed record.

3. The present stipulation supersedes the prior "Stipulation for Record Upon Review in the Supreme Court of the United States" filed July 13, 1948.

Charles L. Byron, John F. Oberlin, Ashley M. Van Duzer, James R. Stewart, Thomas V. Koykka. By John F. Oberlin, Attorneys for Graver Tank & Mfg. Co., Inc., The Lincoln Electric Company, and Graver Tank & Mfg. Corporation.

John T. Cahill, Richard Russell Wolfe, James A. Fowler, Jr., Loftus E. Becker. By Loftus E. Becker, Attorneys for The Linde Air Products Company.

[fol. 1446a] [File endorsement omitted]